

MOOREBANK PRECINCT WEST (MPW) - STAGE 2 AMENDED PROPOSAL

Biodiversity Assessment Report

MARCH 2019

Incorporating



CONTACT





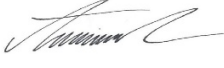
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SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA) MPW STAGE 2

Biodiversity Assessment Report

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This report has been prepared for SIMTA in accordance with the terms and conditions of appointment for MPW Stage 2 dated 2 September 2015. (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

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GLOSSARY

The table below provides a glossary the key acronyms used within this technical report.

| Term | Meaning |
|-----------------|--|
| Acronyms | |
| BAR | Biodiversity Assessment Report |
| BOS | Biodiversity Offset Strategy |
| CEMP | Construction Environmental Management Plan |
| CFFMP | Construction Flora and Fauna Management sub-plan |
| DoEE | Commonwealth Department of Environment and Energy |
| EEC | Endangered Ecological Community |
| EIS | Environmental Impact Statement |
| EP&A Act | <i>Environmental Planning and Assessment Act 1979</i> |
| EPBC Act | <i>Environment Protection and Biodiversity Conservation Act 1999</i> |
| FBA | Framework for Biodiversity Assessment |
| FFMP | Flora and Fauna Management Plan |
| LCC | Liverpool City Council |
| MNES | Matters of National Environmental Significance |
| OEH | NSW Office of Environment and Heritage |
| OSD | On-site Detention |
| PCT | Plant Community Type |
| SEPP | <i>State Environmental Planning Policy</i> |
| SSFL | Southern Sydney Freight Line |
| TEC | Threatened Ecological Communities |
| TSC Act | <i>Threatened Species Conservation Act 1995</i> |

1 INTRODUCTION

On the 3 June 2016 Concept Approval (SSD 5066) was granted, under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to develop the Moorebank Precinct West Project (MPW Project) on the western side of Moorebank Avenue, Moorebank, in south-western Sydney (the MPW Site).

The MPW Project involves the development of intermodal freight terminal facilities (IMT), linked to Port Botany, the interstate and intrastate freight rail network. The MPW Project includes associated commercial infrastructure (i.e. warehousing), a rail link connecting the MPW Site to the Southern Sydney Freight Line (SSFL), and a road entry and exit point from Moorebank Avenue.

Under the Concept Approval, the MPW Project is to be developed in four phases, being:

- Early Works development phase, comprising:
 - The demolition of existing buildings and structures
 - Service utility terminations and diversion/relocation
 - Removal of existing hardstand/roads/pavements and infrastructure associated with existing buildings
 - Rehabilitation of the excavation/earthmoving training area (i.e. 'dust bowl')
 - Remediation of contaminated land and hotspots, including areas known to contain asbestos, and the removal of:
 - Underground storage tanks (USTs)
 - Unexploded ordnance (UXO) and explosive ordnance waste (EOW) if found
 - Asbestos contaminated buildings
 - Archaeological salvage of Aboriginal and European sites
 - Establishment of a conservation area along the Georges River
 - Establishment of construction facilities (which may include a construction laydown area, site offices, hygiene units, kitchen facilities, wheel wash and staff parking) and access, including site security
 - Vegetation removal, including the relocation of hollow-bearing trees, as required for remediation and demolition purposes
- Development of the IMT facility and initial warehousing facilities
- 'Ramp up' of the IMT capacity and warehousing
- Development of further warehousing.

Approval for the Early Works phase (MPW Concept Approval) was granted as the first stage of the MPW Project within the Concept Approval. Works, approved as part of this stage commenced in the third quarter of 2016.

Commonwealth Approval (No. 2011/6086), under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), was also granted in mid 2016 (soon after the Concept Approval for the MPW Project). In addition to this, the Planning Proposal (PP_2012_LPOOL_004_00) which provided a rezoning of part of the MPW Site, and surrounds, was gazetted on 24 June 2016, amending the *Liverpool Local Environmental Plan 2008* (Amendment No. 62).

On 5 December 2014, Moorebank Intermodal Company (MIC) and SIMTA announced their in-principle agreement to develop the Moorebank IMT Precinct on a whole of precinct basis. This was subject to satisfying several conditions which both parties completed in early 2017 and the agreement was finalised shortly thereafter. SIMTA is therefore seeking approval to build and operate Stage 2 of the MPW Concept Approval which includes the IMT facility and warehousing, known as the MPW Stage 2 Proposal (the Proposal).

An Environmental Impact Statement (EIS) was prepared for the Proposal seeking approval under Part 4, Division 4.1 of the *Environmental Planning and Assessment*

Act 1979 (EP&A Act). In particular, the EIS was prepared to address, and be consistent with, the following:

- The Secretary's Environmental Assessment Requirements (SEARs) (SSD 16-7709) for the Proposal, which were issued on 14 July 2016
- The relevant requirements of the MPW Concept Approval (SSD 5066) granted by the Planning Assessment Commission (PAC) on 3 June 2016
- The relevant requirements of the approval under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) (No. 2011/6086).

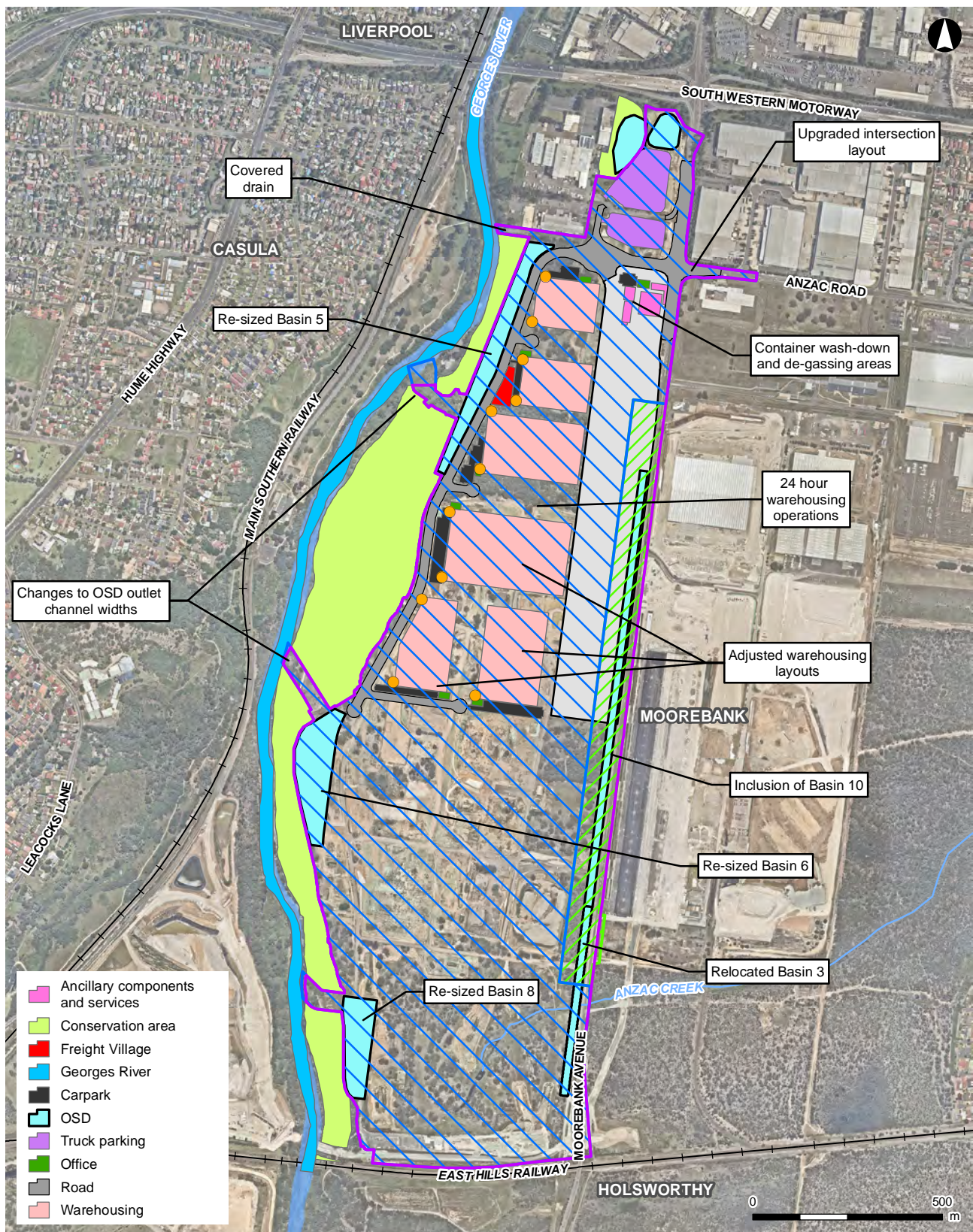
The EIS was publicly exhibited, in accordance with clause 83 of the *Environmental Planning and Assessment Regulations 2000* (EP&A Regulations), between 26 October 2016 and 25 November 2016. During this exhibition period submissions were invited from all stakeholders including members of the community and government stakeholders. The EIS included a Biodiversity Assessment Report (BAR) prepared by Arcadis (2016).

In response to the submissions received, and also to respond to design progression, amendments have been made to the Proposal (now known as the Amended Proposal), namely:

- Align the operational hours for warehouses to the IMT facility and Port freight operations to enable freight movements outside of peak traffic times.
- Drainage works:
 - Inclusion of the OSD (Basin 10) and relocation of another OSD (Basin 3) along the eastern boundary of the operational area, adjacent to the western verge of Moorebank Avenue
 - Re-sizing of OSD basins along the western boundary of the operational area
 - Reduction to the widths of selected OSD outlet channels
 - Provision of an additional covered drain within the Endeavour Energy easement
- Identification of container wash-down facilities and de-gassing areas within the IMT facility
- Illuminated backlit signage within the warehousing area
- Inclusion of an upgraded layout for the Moorebank Avenue/Anzac Road intersection
- Adjustments to warehouse layouts.

The Amended Proposal, at the Amended Proposal Site, includes both the MPW Stage 2 Site and the Moorebank Avenue Site. The Amended Proposal components are shown in Figure 1-1. A more detailed description of the Amended Proposal is provided in section 1.2. A Response to Submissions Report (RtS) was prepared by Arcadis and included an updated BAR (Arcadis, 2017) to update the impacts of the MPW Stage 2 Proposal in consideration of the Amended Proposal (proposal amendments listed above).

This BAR has been prepared by accredited ecologists to support the assessment of the MPW Stage 2 Proposal by the Department of Planning (DP&E) and the Office of Environment and Heritage (OEH). This BAR replaces the BARs that were prepared to support the EIS and the RtS for the MPW Stage 2 Proposal.



1.1 Purpose of this report

This BAR replaces the BAR prepared to support the EIS (Arcadis 2016), the RtS (Arcadis 2017a) and the updated BAR (post RtS) (Arcadis 2017b), and has been prepared to support DP&E's (and OEH's) assessment of the MPW Stage 2 Proposal. This BAR provides the following additional information:

- Amendment to the methodology for quantifying and assessing impacts to *Hibbertia puberula* subsp *puberula* following advice from OEH that the area of occupancy rather than the number of stems should be used (See Section 4.2.4)
- Updated FBA calculations relating to impacts to *Hibbertia puberula* subsp *puberula* based on the area of occupancy methodology (see Section 8)
- Amendment to the offset credit yield from the Moorebank Precinct biobank site to reflect the latest BAR for the biobank site (WSP 2018) (see Section 10).
- Amendments throughout the document to address potential impacts to Koala and Cumberland Plain Land Snail following the unexpected records for both of these species from adjacent lands in November 2018 and subsequent additional targeted surveys in December 2018.

This report has been prepared as part of a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the EP&A Act.

This BAR has been prepared in accordance with the NSW *Framework for Biodiversity Assessment* (FBA) (OEH 2014) by Jane Rodd, accredited under s142B(1) of the *Threatened Species Conservation Act 1995* (Accreditation Number 0023) to apply the FBA, which is the assessment methodology that is adopted by the NSW Offset Policy for Major Projects.

1.1.1 Secretary's Environmental Assessment Requirements

This report has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) (ref: SSD 16-7709 and dated 14 July 2016), and revised environmental mitigation measures (REMMs) identified in the MPW Concept Approval (SSD_5066). Table 1-1 provides a summary of the SEARs and the REMMs from the MPW Concept Approval, which are relevant to this report and the section where they have been addressed in this report.

Table 1-1 Assessment requirements

| Section/ number | SEAR / CoA / REMM | Where addressed in this report |
|--------------------|---|--------------------------------------|
| SEARs | | |
| 12. | Biodiversity – including but not limited to: A Flora and Fauna assessment. The assessment shall: | |
| a) | assess impacts on the biodiversity values of the site and adjoining areas, including Endangered (and vulnerable) Ecological Communities and threatened flora and fauna species and their habitat, groundwater dependent ecosystems, impacts on wildlife and habitat corridors, riparian land, and habitat fragmentation and details of mitigation measures. The assessment shall be undertaken in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by | Sections 6, 7, 8 and 9 |

| Section/ number | SEAR / CoA / REMM | Where addressed in this report |
|--------------------|--|--|
| | OEH, by a person accredited in accordance with s142B(1)(c) of the <i>Threatened Species Conservation Act 1995</i> ; | |
| b) | consideration of the OEH's Threatened Species Survey and Assessment Guidelines (www.environment.nsw.gov.au/threatenedspecies/surveyassessmentguids.htm), any relevant draft or final recovery plans, and Commonwealth Significant Impact Guidelines; | This assessment relies on the detailed site assessments conducted by PB (2014a, 2015a and 2015b) – see Section 4 |
| c) | assess and document impacts related to the proposed project in accordance with the Framework for Biodiversity Assessment (OEH 2014), unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the <i>Threatened Species Conservation Act 1995</i> . This assessment shall include consideration of any new impacts that are outside of previous assessments; and | This report has been prepared in accordance with the FBA. |
| d) | include a comprehensive offset strategy, or provide an updated strategy (including any new impacts if relevant), in accordance with the NSW Biodiversity Offsets Policy for Major Projects including the Framework for Biodiversity Assessment (OEH 2014), consistent with the 'avoid, minimise or offset' principle. | A Biodiversity Offset Strategy (BOS) for the MPW Project is being prepared as part of the MPW Concept Approval. Further discussion in Section 10. |
| 8. | Soil and Water | |
| a) | assess impacts on surface and groundwater flows, quality and quantity, with particular reference to any likely impacts on dragonfly species listed under the <i>Fisheries Management Act 1994</i> , the Georges River and Anzac Creek; | Section 7.3 Section 8.2 |
| REMMs | | |
| 6A | <p>Following detailed design and before construction, detailed flora and fauna mitigation measures would be developed and presented as part of the CEMP. These detailed measures would incorporate the measures listed in 6B to 6W.</p> <p>The CEMP would address:</p> <ul style="list-style-type: none"> • general impact mitigation; • staff/contractor inductions; • vegetation clearing protocols; • pre-clearing surveys and fauna salvage/translocation; • rehabilitation and restitution of adjoining habitat; | Section 9, Table 9-1 |

| Section/ number | SEAR / CoA / REMM | Where addressed in this report |
|--------------------|--|--------------------------------------|
| | <ul style="list-style-type: none"> • weed control; • pest management; and • monitoring. <p>The plans would include clear objectives and actions for the Project including how to:</p> <ul style="list-style-type: none"> • minimise human interferences to flora and fauna; • minimise vegetation clearing/disturbance; • minimise impact to threatened species and communities; • minimise impacts to aquatic habitats and species; and • undertake flora and fauna monitoring at regular intervals. | |
| 6B | Vegetation clearing would be restricted to the construction footprint and sensitive areas would be clearly identified as exclusion zones. | Section 9, Table 9-1 |
| 6C | The exclusion zones would be marked on maps, which would be provided to contractors, and would also be marked on the ground using high visibility fencing (such as barrier mesh). | Section 9, Table 9-1 |
| 6D | A trained ecologist would accompany clearing crews to ensure disturbance is minimised and to assist in relocating any native fauna to adjacent habitat. | Section 9, Table 9-1 |
| 6E | <p>A staged habitat removal process would be developed and would include the identification and marking of all habitat trees in the area.</p> <p>Where reasonable and feasible, clearing of hollow-bearing trees would be undertaken in March and April when most microbats are likely to be active (not in torpor) but are unlikely to be breeding or caring for young, and when threatened hollow-dependent birds in the locality are also unlikely to be breeding.</p> <p>Pre-clearing surveys would be conducted 12 to 48 hours before vegetation clearing to search for native wildlife (e.g. reptiles, frogs, Cumberland Land Snail) that can be captured and relocated to the retained riparian vegetation of the Georges River corridor.</p> <p>Vegetation would be cleared from a 10 m radius around habitat trees to encourage animals roosting in hollows to leave the tree. A minimum 48 hour waiting period would allow animals to leave.</p> <p>After the waiting period, standing habitat trees would be shaken (where safe and practicable) under the supervision of an ecologist to encourage animals roosting in hollows to leave the trees, which may then be felled, commencing with the most distant trees from secure habitat.</p> | Section 9, Table 9-1 |

| Section/ number | SEAR / CoA / REMM | Where addressed in this report |
|--------------------|---|--|
| | <p>Felled habitat trees would either be immediately moved to the edge of retained vegetation, or left on the ground for a further 24 hours before being removed from the construction area, at the discretion of the supervising ecologist.</p> <p>All contractors would have the contact numbers of wildlife rescue groups and would be instructed to coordinate with these groups in relation to any animal injured or orphaned during clearing.</p> <p>Within areas of high quality intact native vegetation proposed to be removed:</p> <ul style="list-style-type: none"> • topsoil (and seedbank) is to be collected from native vegetation that are to be permanently cleared and used in the revegetation of riparian areas; and • Native plants in areas that are to be permanently cleared are to be relocated and transplanted in riparian areas identified for rehabilitation | |
| 6F | Relocation of fauna to adjacent retained habitat would be undertaken by an ecologist during the supervision of vegetation removal. | Section 9, Table 9-1 |
| 6G | An ecologist would supervise the drainage of any waterbodies on the Project site and would relocate native fish (e.g. eels), tortoises and frogs to the edge of the Georges River and/or the existing pond at the northern end of the IMT site. | Section 9, Table 9-1 |
| 6H | The design of site fencing and any overhead powerlines would consider the potential for collision by birds and bats and minimise this risk where practicable. | Section 9, Table 9-1 |
| 6I | The potential for translocation of threatened plant species as individuals or as part of a soil translocation process would be considered during the detailed development of the CEMP. | Section 9, Table 9-1 |
| 6J | Consideration would be given to fitting roost boxes to the bridge over the Georges River to provide roost sites for the Large-footed Myotis and other species of microbats (e.g. Eastern Bentwing-bat) which may utilise such structures. Provision of roost boxes under bridges has been identified as priority action for the recovery of the Large-footed Myotis. | N/A – Georges River Bridge is not part of the current Proposal |
| 6K | Important habitat elements (e.g. large woody debris) would be moved from the construction area to locations within the conservation area which would not be cleared during the Project, or to stockpiles for later use in vegetation/habitat restoration. | Section 9, Table 9-1 |
| 6L | Winter-flowering trees would be preferentially planted in landscaped areas of the Project site to provide a winter foraging resource for migratory and nomadic nectar-feeding birds and the Grey-headed Flying-fox. | Section 9, Table 9-1 |

| Section/ number | SEAR / CoA / REMM | Where addressed in this report |
|--------------------|---|--|
| 6M | A bridge/viaduct or similar design would be used for the railway crossing of the Georges River. This may allow connectivity of terrestrial habitat along the river banks underneath the bridge | N/A – Georges River Bridge is not part of the current Proposal |
| 6N | Options for maintaining habitat connectivity would be investigated, and may include establishing native vegetation and placing habitat elements such as rock piles and large woody debris under the bridge to provide cover for fauna. Where reasonable and feasible options to allow light and moisture to penetrate under the Georges River bridge will be incorporated into the detailed design. | N/A – Georges River Bridge is not part of the current Proposal |
| 6O | Erosion and sediment control measures such as silt fencing and hay bales would be used to minimise sedimentation of streams and resultant impacts on aquatic habitats and water quality. | Section 9, Table 9-1 |
| 6P | The detailed design process for the bridge over the Georges River would consider disturbance to aquatic habitat and fish passage conditions. The design would as a minimum adhere to the fish friendly passage guidelines (Fairfull & Witheridge 2003) for waterway crossings. | N/A – Georges River Bridge is not part of the current Proposal |
| 6Q | Opportunities for planting of detention basins with native aquatic emergent plants and fringing trees would be explored in the detailed design of the Project and, if practicable, implemented so that they would provide similar habitat in the medium term to that lost through the removal of existing basins. | Section 9, Table 9-1 |
| 6R | The CEMP (or equivalent) would include detailed measures for minimising the risk of introducing weeds and pathogens. | Section 9, Table 9-1 |
| 6S | The Project would include a long-term program for the duration of the Project operation of weed removal and riparian vegetation restoration within parts of the Georges River corridor, which would include monitoring landscaped areas for the presence of noxious and environmental weeds. A preliminary weed management strategy is provided in Appendix E of Technical Paper 3 – Ecological Impact Assessment in Volume 4 of the EIS, setting out the principles for the management of the riparian zone. | Section 9, Table 9-1 |
| 6T | Appropriate design and landscape/vegetation management measures would be implemented to reduce the bushfire risk and threat to biodiversity. | Section 9, Table 9-1 |
| 6U | The management of the conservation area along the Georges River would include management of fire regimes to promote biodiversity conservation. | Section 9, Table 9-1 |

| Section/ number | SEAR / CoA / REMM | Where addressed in this report |
|--------------------|--|---|
| 6V | The detailed design process would consider the potential groundwater impacts on ground-dependent ecosystems. In most cases, these impacts would be mitigated at the design phase. | Section 9, Table 9-1 |
| 6W | The management plan for the Georges River riparian corridor (refer to Appendix E of Technical Paper 3 – Ecological Impact Assessment in Volume 4 of the EIS) would be implemented and would include a monitoring program designed to detect operational impacts. | Section 9, Table 9-1 |
| CoAs | | |
| E15 | All future Development Applications shall consider measures to improve the condition of the riparian corridor along the western bank of the Georges River (known as the 'hourglass land'). | Section 10.2.1 |
| E16 | All future Development Applications shall consider the following riparian corridor widths (measured from the top of bank): a) a minimum of 50 m wide associated with the rail corridor; and b) a minimum of 40 m wide along the terminal site. | Section 8.2.1.4 |
| E22 | All future Development Application which includes construction in the vicinity of the Amiens Wetland shall include advice from an independent wetland expert to determine whether it is artificial or a natural lake basin, its significance, and any recommendations on mitigation measures (if appropriate). | An assessment of Amiens Wetland has been conducted by an independent wetland expert (Appendix Q). The assessment is discussed in Section 5.3 of the EIS and Appendix G of this RtS. |

1.2 Description of the Amended Proposal

1.2.1 MPW Stage 2 Proposal (EIS)

The Proposal, as detailed in the EIS, involves the construction and operation of an Intermodal terminal (IMT) facility and associated warehousing.

The IMT facility would have the necessary infrastructure to support a container freight throughput volume of 500,000 twenty-foot equivalent units (TEUs) per annum. Specifically, the IMT facility within the Amended Proposal Site would include the following key components:

- Truck processing, holding and loading areas – with entrance and exit from Moorebank Avenue via an upgraded intersection and a round-about to distribute traffic between the warehousing precinct and the IMT
- Rail loading and container storage areas – installation of nine rail sidings, with an adjacent container storage area serviced by manual handling equipment
- Administration facility – office building with associated car parking and light vehicle access from Moorebank Avenue
- The Rail link connection – rail sidings within the IMT facility, which would be linked (to the south – to the Rail link (constructed as part of the MPE Project (SSD 14-6766)).

Also included within the Proposal are the following key components:

- Warehousing area – construction and operation of approximately 215,000 m² GFA of warehousing, with warehouses ranging in size from 4,000 m² to 71,000 m². Included within the warehousing area would be ancillary offices, truck and light vehicle parking, associated warehouse access roads.
- Upgraded intersection on Moorebank Avenue and internal road – including works to Moorebank Avenue, Anzac Road to accommodate the proposed site entrance to Moorebank Avenue, and construction of an internal road.
- Ancillary works – including vegetation clearing, earth works, drainage and on-site detention, utilities installation/connection, signage and landscaping.

1.2.2 MPW Stage 2 Amended Proposal (RtS)

The Amended Proposal, as detailed in the RtS, involves proposed amendments to the MPW Stage 2 Proposal, in order to respond to submissions received during exhibition of the EIS, consultation with key stakeholders and design development. Key components of the Amended Proposal (shown above in Figure 1-1) include:

- Align the operational hours for warehouses to the IMT facility and Port freight operations to enable freight movements outside of peak traffic times.
- Alterations to the drainage design, including:
 - Inclusion of the OSD (Basin 10) and relocation of another OSD (Basin 3) along the eastern boundary of the operational area, adjacent to the western verge of Moorebank Avenue
 - Re-sizing of OSD basins along the western boundary of the operational area
 - Reduction to the widths of selected OSD outlet channels
 - Provision of an additional covered drain within the Endeavour Energy easement
- Establishment of a container wash-down facility with de-gassing area within the IMT facility
- Illuminated backlit signage within the warehousing area
- Inclusion of an upgraded layout for the Moorebank Avenue/Anzac Road intersection
- Adjustments to warehouse layouts.

1.2.3 MPW Stage 2 Amended Proposal (Assessment)

Additional information (environmental assessment and clarifications) has been submitted to the DP&E, post RtS, to assist with the assessment of the MPW Stage 2 Proposal (Amended Proposal). Further information for the MPE Stage 2 Proposal (SSD 7628) have also been prepared and submitted to DP&E concurrently.

The Moorebank Avenue Site is an area that overlaps with the MPE Stage 2 Site, but is included predominately within the MPW Stage 2 Amended Proposal Site.

Both the MPE Stage 2 BAR and this report have been updated to describe and delineate the biodiversity values and impacts of the removal of all vegetation from the Moorebank Avenue Site. The separate quantification of impacts of clearing the Moorebank Avenue is required by both the MPE Stage 2 BAR and MPW Stage 2 BAR, as the Moorebank Avenue Site (which includes the upgrade of Moorebank Avenue) may be either cleared as part of this Amended Proposal or the MPE Project (SSD 7628), subject to the timing of approvals. Figure 1-2 illustrates the location of the Moorebank Avenue Site with reference to the MPE Site and MPW Site.

It is likely that the MPE Stage 2 Proposal would be approved prior to the MPW Stage 2 Proposal. By separating the biodiversity values and impacts the Moorebank Avenue Site, as described in both the MPE Stage 2 BAR and this report, Arcadis has allowed for the ecosystem and species credit offset requirements for the biodiversity impacts resulting from Moorebank Avenue to be incorporated into both the MPE Stage 2 proposal approval or MPW Stage 2 proposal approval. This would facilitate for the works for both proposal being undertaken on the Moorebank Avenue Site.

For the purpose of this updated BAR, the MPW Stage 2 Site and the Moorebank Avenue Site are described separately where appropriate, so that biodiversity values and impacts of each site are quantified separately.

1.3 Key terms relevant to the Amended Proposal

Table 1-2 provides a summary of the key terms relevant to the Amended Proposal, which are included throughout this report.

Under the FBA, the area subject to impact assessment is referred to as the 'development site'. In this assessment, the extent of the Amended Proposal Site was amended as a result of the RtS Amended Proposal and was described as the Amended Proposal Site (refer to Figure 1-2).

Table 1-2 Summary of key terms used throughout this document

| Term | Definition |
|--|---|
| General terms | |
| The Moorebank Precinct | Refers to the whole Moorebank intermodal precinct, i.e. the MPE Site and the MPW Site |
| Moorebank Precinct West (MPW) Project (formerly the MIC Project) | The MPW Intermodal Terminal Facility as approved under the MPW Concept Plan Approval (SSD_5066) and the MPW EPBC Approval (No. 2011/6086). |
| Moorebank Precinct West (MPW) Site (formerly the MIC site) | The site which is the subject of the MPW Concept Plan Approval, MPW EPBC Approval and MPW Planning Proposal. The MPW Site does not include the rail link as referenced in the MPW Concept Plan Approval or MPE Concept Plan Approval. |
| Moorebank Precinct East (MPE) Concept Plan Approval | MPE Concept Plan Approval (SSD_0193) granted by the NSW Department of Planning and Environment on 29 September 2014 for the development of former defence |

| Term | Definition |
|--|--|
| (formerly the SIMTA Concept Plan Approval) | land at Moorebank to be developed in three stages; a rail link connecting the site to the Southern Sydney Freight Line, an intermodal terminal, warehousing and distribution facilities and a freight village. |
| Moorebank Precinct East (MPE) Project (formerly the SIMTA Project) | The MPE Intermodal Terminal Facility, including a rail link and warehouse and distribution facilities at Moorebank (eastern side of Moorebank Avenue) as approved by the Concept Plan Approval (MP 10_0913) and the MPE Stage 1 Approval (14_6766). |
| Moorebank Precinct East (MPE) Site (formerly the SIMTA Site) | Including the former DSND site and the land owned by SIMTA which is subject to the Concept Plan Approval. The MPE Site does not include the rail corridor, which relates to the land on which the rail link is to be constructed. |
| Statement of Commitments (SoC) | Recommendations provided in the specialist consultant reports prepared as part of the MPE Concept Plan application to mitigate environmental impacts, monitor environmental performance and/or achieve a positive environmentally sustainable outcome in respect of the MPE Project. The Statement of Commitments have been proposed by SIMTA as the Proponent of the MPE Concept Plan Approval. |
| MPW Stage 1 Project-specific terms | |
| Early Works | Works approved under Stage 1 of the MPW Concept Approval (SSD 5066), within the MPW Site, including: establishment of construction compounds, building demolition, remediation, heritage impact mitigation works and establishment of the conservation area. |
| Early Works Approval | Approval for the Early Works (Stage 1) component of the MPW Project under the MPW Concept Approval (SSD 5066) and the MPW EPBC Approval. Largely contained in Schedule 3 of the MPW Concept Approval. |
| Early Works area | Includes the area of the MPW Site subject to the Early works approved under the MPW Concept Approval (SSD 5066). |

| Term | Definition |
|--|---|
| MPW Stage 2 specific terms | |
| MPW Stage 2 Proposal/ the Proposal | MPW Stage 2 Proposal (the subject of the EIS), namely Stage 2 of the MPW Concept Approval (SSD 5066) including construction and operation of an IMT facility, warehouses, a Rail link connection and Moorebank Avenue/Anzac Road intersection works. |
| Proposal Site | The subject of the EIS, the part of the MPW Site which includes all areas to be disturbed by the MPW Stage 2 Proposal (including the operational area and construction area). |
| MPW Stage 2 RtS | This report, which was prepared in response to the submissions received regarding the MPW Stage 2 Proposal. |
| MPE Stage 2 Amended Proposal/the Amended Proposal | The MPW Stage 2 Proposal has been amended (the Amended Proposal) from that provided within the EIS to respond to submissions provided by the government agencies and the community and also as part of design progression of the Proposal. The Amended Proposal is detailed and assessed in the RtS. |
| The Amended Proposal Site/ development site ¹ | The area within the MPW Site, including the Moorebank Avenue Site, which would be disturbed by the MPW Stage 2 Amended Proposal (including the operational area and construction area). |
| The Moorebank Avenue Site | The extent of construction works to facilitate the construction of the Moorebank Avenue upgrade (Figure 1-1). |
| The Moorebank Avenue upgrade | Raising of the vertical alignment of Moorebank Avenue for 1.5 kilometres of its length by about two metres, from the northern boundary of the MPE Site to approximately 120 metres south of the MPE Site. The Moorebank Avenue upgrade also includes upgrades to intersections, ancillary works and the construction of an on-site detention basin to the west of Moorebank Avenue within the MPW Site. |
| Construction area | Extent of construction works, namely areas to be disturbed during the construction of the MPW Stage 2 Amended Proposal (the Amended Proposal). |
| Operational area | Extent of operational activities for the operation of the MPW Stage 2 Amended Proposal (the Amended Proposal). |

¹ Under the FBA, the area subject to impact assessment is referred to as the 'development site'. In this assessment, the development site is considered to encompass the MPW Stage 2 amended proposal site and construction area as shown on Figure 1-2. For the purpose of this report the term Amended Proposal site has been used.

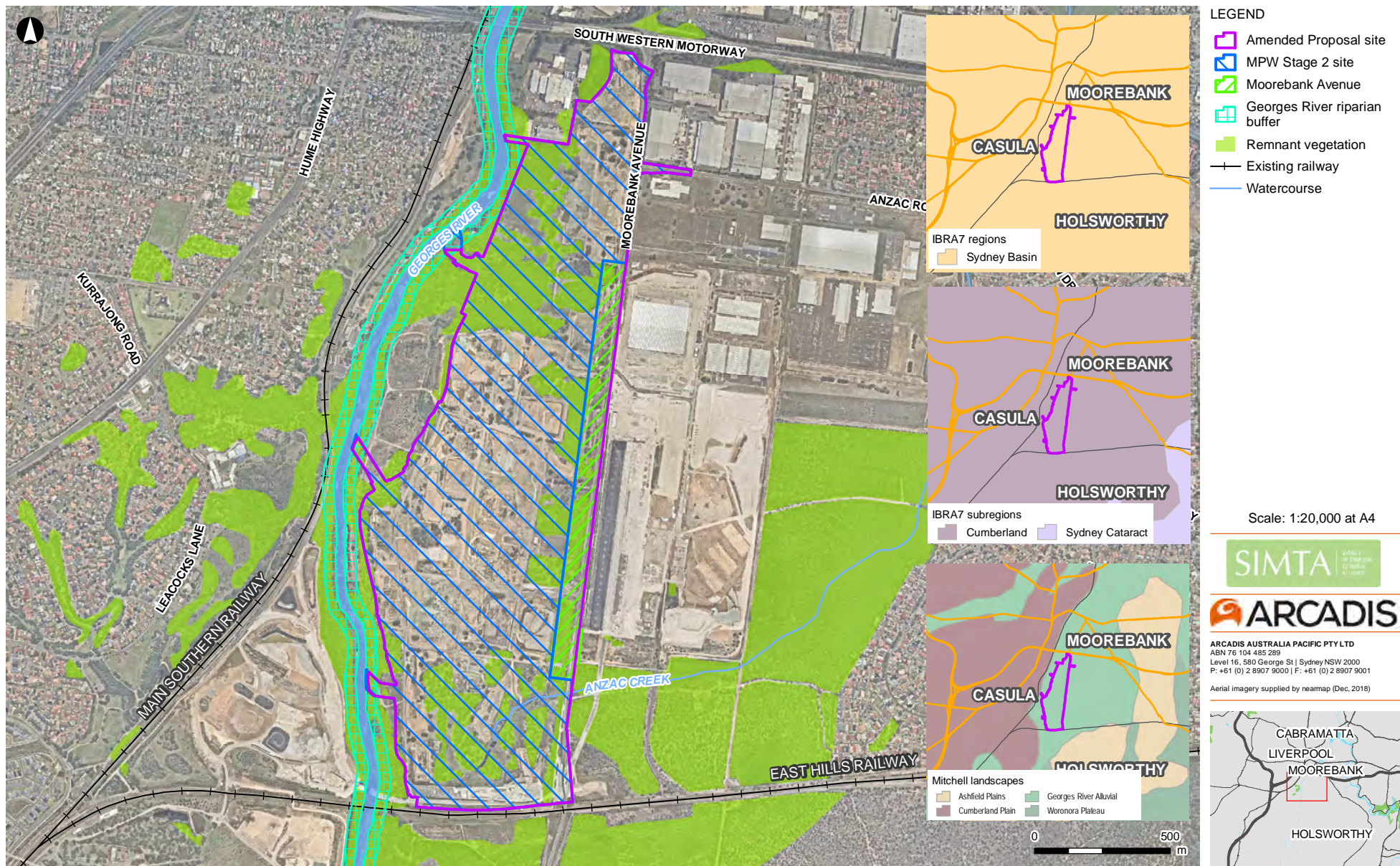


Figure 1-2 Site Map

2 SITE DESCRIPTION

The Amended Proposal Site includes both the MPW Stage 2 Site and the Moorebank Avenue Site.

The Amended Proposal Site is generally bounded by the Georges River to the west, Moorebank Avenue to the east, the East Hills Railway Line to the south and the M5 Motorway to the north. It is located on Moorebank Avenue, Moorebank and forms Lot 1 in Deposited Plan (DP) 1197707². The Amended Proposal Site also contains Lots 100 and 101 DP1049508, which are located north of Bapaume Road and west of Moorebank Avenue. The Amended Proposal Site is located wholly within Commonwealth Land.

The Amended Proposal would also require minor works to be undertaken within (the Moorebank Avenue Site, that would require the removal of all vegetation that currently occurs within the Moorebank Avenue Site.

The key existing features of the Amended Proposal Site are:

- Relatively flat topography, with the western edge flowing down towards the Georges River, which forms the western boundary to the MPW Site
- A number of linked ponds in the south-west corner of the Amended Proposal Site, within the existing golf course, that link to Anzac Creek, which is an ephemeral tributary of the Georges River
- An existing stormwater system comprising pits, pipes and open channels
- Direct frontage to Moorebank Avenue, which is a publicly used private road, south of Anzac Road and a publicly owned and used road north of Anzac Road
- The majority of the Amended Proposal Site has been developed and comprises low-rise buildings (including warehouses, administrative offices, operative buildings and residential buildings), access roads, open areas and landscaped fields for the former School of Military Engineering (SME) and the Royal Australian Engineers (RAE) Golf Course and Club. Defence has since vacated and all buildings on the site are currently unoccupied and will be removed during the Early Works
- Native and exotic vegetation is scattered across the Amended Proposal Site
- The riparian area of the Georges River lies to the west of the Amended Proposal Site and contains a substantial corridor of native and introduced vegetation. The riparian vegetation corridor provides a wildlife corridor and a buffer for the protection of soil stability, water quality and aquatic habitats. This area has been defined as a conservation area as part of the MPW Concept Approval
- As stated above, the majority of the Amended Proposal Site has been developed, however heritage and biodiversity values still remain on the site
- A strip of land (up to approximately 250 metres wide) along the western edge of the Amended Proposal Site lies below the 1% annual exceedance probability (AEP) flood level
- The Amended Proposal Site is privately owned by the Commonwealth and leased by SIMTA.

A number of residential suburbs are located in proximity to the MPW Site, including:

- Wattle Grove, located approximately 1,000 m from the MPW Site and 1,000 m from the rail link connection to the east. The rail link, which will be used during operation of the Proposal is 1,260 m to the west of Wattle Grove at its closest point

² Previously legally described as “Lot 3001, DP 1125930” in the MPW Concept Approval (SSD 5066), however has since been subdivided.

- Moorebank, located approximately 630 m from the MPW Site and more than 1,400 m from the rail link connection to the north. The rail link is 2,500 m to the south of Moorebank at its closest point
- Casula, located approximately 330 m from the MPW Site and 1,200 m from the rail link connection to the west. The rail link is approximately 290 m to the east of Casula at the closest point
- Glenfield, located approximately 820 metres from the MPW Site and 1,100 metres from the rail link connection to the south-west. The rail link is approximately 750 m to the east of Glenfield at its closest point.

3 LEGISLATION AND POLICY

3.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (MNES). MNES identified in the EPBC Act include:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Threatened species and communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mines).

In accordance with sections 67 and 67A of the EPBC Act, any works that have the potential to result in an impact on any MNES or on Commonwealth land are considered 'controlled actions' and require a referral to the Federal Minister for the Environment for approval. The MPW Project was determined to be a controlled action under the EPBC Act, EPBC Reference 2011/6086, and the MPW Concept EIS was prepared to address the requirements of the EPBC Act assessment requirements. The MPW Project was granted approval as a controlled action under the EPBC Act in late 2016 (MPW EPBC Approval).

3.2 NSW Environmental Planning and Assessment Act 1979

Approval of the MPW Project (SSD 5066) was granted on 3 June 2016 under Division 4.1, Part 4 of the EP&A Act, by the Planning Assessment Commission (PAC). The MPW Concept Approval included approval of:

- Concept Proposal: involving the use of the site as an intermodal facility, including a rail link to the Southern Sydney Freight Line, warehouse and distribution facilities, and associated works; and
- Early Works (Stage 1): involving the demolition of buildings and existing hardstand, services termination and diversion; rehabilitation of the excavation/ earthmoving training area; remediation of contaminated land; removal of underground storage tanks; heritage impact remediation works; and the establishment of construction facilities and access, including site security.

Clause 2, Schedule 2 of the MPW Concept Approval prescribes that all development, other than the Early Works, shall be the subject of future development applications. Approval of any subsequent development applications must be consistent with the terms of the MPW Concept Approval, as described in Schedule 1 and subject to the conditions in Schedule 4 of the approval.

The Amended Proposal would involve construction and operation of an intermodal terminal facility, warehouses and Rail link connection. Under Schedule 1, Clause 19 of *State Environmental Planning Policy (State and Regional Development) 2011*

(SEPP (S&RD)) development for the purposes of 'rail and related transport facilities', including railway freight terminals, sidings and inter-modal facilities with a capital investment value of more than \$30 million is classified as State significant development (SSD). Furthermore, Schedule 1, Clause 12 of SEPP(S&RD) states that a development that has a capital investment value of more than \$50 million for the purpose of warehouses or distribution centres (including container storage facilities) at one location and related to the same operation' is also classified as an SSD. The capital cost of the Proposal is estimated to be approximately \$533,000,000 million. Therefore the Proposal (and Amended Proposal) is classified as SSD, and assessable under Division 4.1, Part 4 of the EP&A Act.

3.2.1 NSW Biodiversity Offsets Policy for Major Projects and the Biodiversity Offsets Scheme

The *NSW Biodiversity Offsets Policy for Major Projects* was released in October 2014 and is applicable to projects that are SSD or State significant infrastructure (SSI) under the EP&A Act. The NSW Biodiversity Offsets Policy for Major Projects requires proponents to apply the *Framework for Biodiversity Assessment* (FBA) to assess impacts on biodiversity. The FBA also guides the identification of reasonable measures and strategies that can be taken to avoid and minimise impacts on biodiversity associated with a proposal.

The Biodiversity Offsets Policy for Major Projects has recently been replaced by the Biodiversity Offsets Scheme, which was established by the *Biodiversity Conservation Regulation 2017* commencing on 25 August 2017. The Biodiversity Offsets Policy for Major Projects and the FBA are still relevant for savings and transitional arrangements, including for all development applications (DAs) for which SEARs have been issued. The SEARs for the Amended Proposal (SSD 16-7709) were issued prior to 25 August 2017, and the Amended Proposal has been assessed in accordance with the Biodiversity Offsets Policy for Major Projects and the FBA, as required by the SEARs.

3.3 NSW Threatened Species Conservation Act 1995 and Biodiversity Conservation Act 2016

The NSW *Threatened Species Conservation Act 1995* (TSC Act) provides for the protection and management of threatened species, populations and ecological communities listed under schedules 1, 1A and 2 of the TSC Act. The purpose of the TSC Act is to:

- Conserve biological diversity and promote ecologically sustainable development.
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities.
- Protect the critical habitat of those species, populations and ecological communities that are endangered.
- Eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities.
- Ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed.
- Encourage the conservation of threatened species, populations and ecological communities through co-operative management.

The TSC Act was repealed on 25 August 2017 and replaced with the *Biodiversity Conservation Act 2016* (BC Act). The BC Act incorporates broadly similar objectives to those identified the TSC Act, and additionally seeks to establish a framework for

assessment and offsetting of development impacts as well as investment in biodiversity conservation.

As described in section 3.2.1, the Biodiversity Offsets Policy for Major Projects and the FBA are still relevant for savings and transitional arrangements, under which this BAR falls. Accordingly, the Amended Proposal has been assessed in accordance with the Biodiversity Offsets Policy for Major Projects and the FBA, as required by the SEARs, and outlines the corresponding offsetting requirements.

3.4 NSW Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) provides for the identification, conservation and recovery of threatened fish, aquatic invertebrates and marine vegetation. The Act also covers the identification and management of key threatening processes which affect threatened species or could cause other species to become threatened.

If a planned development or activity is likely to have any impact on a threatened species listed under the FM Act, an Assessment of Significance must be undertaken. If the impacts are likely to be significant, or if critical habitat is affected, a species impact statement must be prepared in accordance with Part 7A of the FM Act.

The FM Act requires permits for the harming of aquatic vegetation, blockage of fish passage and dredging and reclamation. Though the Amended Proposal could result in these impacts, Clause 89J of the EP&A Act provides an exemption for these permits for SSD assessed under Part 4, Division 4.1 of the EP&A Act.

4 METHODOLOGY

4.1 Desktop Assessment

4.1.1 Database Interrogation

Database searches were undertaken to identify records, classifications and habitat descriptions of threatened entities under the TSC Act. Databases interrogated for this purpose were:

- The NSW Threatened Species Profile Database (TSPD) which is managed by OEH.
- The Vegetation Information System (VIS) classification database which is managed by OEH.
- The over-cleared landscapes database (Mitchell landscapes)
- The Directory of Important Wetlands of Australia (DIWA), maintained by the Australian Government.

4.1.2 Literature Review

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring in the Amended Proposal Site and wider region. Reports, vegetation maps, topographic maps, aerial photography and literature reviewed included, but were not limited to, the following:

- *Soil Landscapes of the Penrith 1:100 000 Sheet* (Bannerman & Hazelton 1990).
- *Interpretation Guidelines for the Native Vegetation of the Cumberland Plain* (NPWS 2002a).
- *Conservation significance guidelines for the Native Vegetation of the Cumberland Plain* (NPWS 2002b).
- *Moorebank Intermodal Terminal – Ecological Impact Assessment* (Parsons Brinckerhoff (PB) 2014a).
https://majorprojects.affinitylive.com/public/f47206dc2358ff1265fb0478db877546/051%20Technical%20Paper%203_%20Ecological%20Impact%20Assessment.pdf
- *Biodiversity Offset Strategy*. Appendix C of the Moorebank Intermodal Terminal Response to Submissions Report (PB 2015a)
- *Framework for Biodiversity Assessment credit report*. Appendix A of Appendix C of the Moorebank Intermodal Terminal Response to Submissions Report (PB 2015b).
- *Biodiversity Offset Areas Biodiversity Assessment Report*. Appendix A of the Moorebank Intermodal Terminal Supplementary Response to Submissions Report (PB 2015c)

4.1.3 Vegetation mapping

Vegetation mapping reviewed for this study is as follows:

- *Native vegetation maps of the Cumberland Plain, western Sydney* (NPWS 2002c).
- *The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities* (Tozer 2003).
- *Changes in the distribution of Cumberland Plain Woodland* (NSW Scientific Committee and Simpson 2008).

- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (DECCW 2009).
- *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands* (Tozer et al. 2006)
- Vegetation mapping prepared by Parsons Brinckerhoff (2014-2015), based on detailed site surveys.

4.2 Field assessment

Field assessment of the biodiversity values of the Amended Proposal Site has been conducted on numerous occasions between November 2010 and September 2014, as documented in PB (2014a). A detailed field investigation to quantify offset requirements in accordance with the FBA/BioBanking Assessment Methodology was undertaken during daylight hours by a team of two ecologists on 5, 20, 21, 22 and 23 May 2014 (PB 2015b).

Arcadis ecologists, Jane Rodd and Laura Hoffman, inspected the site on 3 March 2016. Areas of native vegetation on the MPW Site were inspected, with particular focus on the areas to be impacted within the Georges River riparian zone.

Additional field assessment was undertaken on 9 and 14 February 2017 and 14 March 2017, targeting threatened flora species (*Hibbertia puberula* subsp. *puberula* and *Hibbertia fumana*). On 3 and 16 November 2017, the previous identification of *Hibbertia* spp. in the Amended Proposal Site was validated by carrying out a survey in the species' flowering period, in accordance with FBA requirements. As specified by the NSW Scientific Committee Final Determination for the species, *Hibbertia puberula* subsp. *puberula* flowers between October and November.

Mapped vegetation patches within the Amended Proposal Site were also inspected to confirm their boundaries and condition.

Following the detection of Koala and Cumberland Plain Land Snail within the Bootland on 9 November 2018, additional surveys were undertaken by Cumberland Ecology ecologists across the Amended Proposal Site as well as adjacent lands between 30 November 2018 and 7 December 2018. The purpose of these surveys was to determine whether either of these two target species are present within the Amended Proposal Site and if so, the potential size of the population present.

4.2.1 Vegetation Plots

Vegetation plot surveys were undertaken as outlined in the methodology contained within BioBanking Operational Manual (DECC 2009) and described below. Sixteen BioBanking plots sampling the Amended Proposal Site were used in the calculation for the current assessment. Quadrat sampling was conducted in May 2014.

Figure 4-1 shows the location of the plots. The following site attributes were recorded at each site:

- Location (easting – northing grid type MGA 94, Zone 56).
- Vegetation structure and dominant species and vegetation condition. Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer. Vegetation condition was recorded in accordance with the BioBanking methodology.
- Native and exotic species richness (within a 400 m² quadrat): This consisted of recording all species by systematically walking through each 20 x 20 m quadrat. The cover abundance (percentage of area of quadrat covered) of each species was estimated.

- Number of trees with hollows (1,000 m² quadrat): This was the frequency of hollows within living and dead trees within each 50 x 20 m quadrat. A hollow was only recorded if:
 - (a) the entrance could be seen;
 - (b) the estimated entrance width was at least 5 cm across;
 - (c) the hollow appeared to have depth;
 - (d) the hollow was at least 1 m above the ground; and
 - (e) the centre of the tree was located within the sampled quadrat.
- Total length of fallen logs (1,000 m² quadrat): This was the cumulative total of logs within each 50 x 20 m quadrat with a diameter of at least 10 cm and a length of at least 0.5 m.
- Native overstorey cover: This consisted of estimating the percentage foliage projective cover of the tallest woody stratum present (>1 m and including emergents). The woody stratum included species that were native to New South Wales including both indigenous and non-indigenous native species.
- Native mid-storey cover: This involved estimating the foliage projective cover of vegetation between the overstorey stratum and a height of 1 m (i.e. tall shrubs, under-storey trees and tree regeneration).
- Ground cover: This comprised estimating the foliage projective cover of plants below 1 m in height. The following categories of plants were recorded:
 - Native ground cover (grasses): native grasses (Poaceae family native to NSW).
 - Native ground cover (shrubs): all woody vegetation below 1 m in height and native to New South Wales.
 - Native ground cover (other): non-woody vegetation (i.e. vascular plants – ferns and herbs) below 1 m in height and native to New South Wales.
- Exotic plant cover: vascular plants not native to Australia.
- Evaluation of regeneration: This was estimated as the proportion of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height >5 cm). The maximum value for this measure was 1.

4.2.2 Targeted threatened species surveys

Numerous flora and fauna field surveys were conducted in 2010 as part of the original MPW Environmental Impact Assessment (Parsons Brinckerhoff 2011), including targeted surveys for those threatened species considered likely to occur. The surveys included:

- Targeted threatened plant surveys using random meanders, quadrats and BBAM survey techniques as described above
- Night time water bodies searches for Green and Golden Bell Frog
- Targeted diurnal and nocturnal call – playback for threatened bird surveys for species such as the Regent Honeyeater, Swift Parrot and Powerful Owl
- Habitat searches for species such as the Cumberland Plain Land Snail
- Mammal trapping and hair tubes for species such as Spotted-tailed Quoll and Squirrel Glider
- Bat (harp) trapping and ANABAT detection for threatened bat species such as Eastern Bent-wing Bat and Large-footed Myotis

- Opportunistic observations.

Surveys undertaken between 2011 and 2014 (PB 2014a) include:

- A tree hollow survey conducted in September 2011 to estimate the number of hollow bearing trees likely to be affected.
- Targeted threatened species surveys in September 2014.

Details of threatened species survey methodology are provided in PB (2014a).

Additional surveys conducted in 2017 included:

- Targeted searches for threatened plant species within areas of potential suitable habitat, comprising areas mapped as Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Woodland. Species targeted were: *Hibbertia puberula* subsp. *puberula*, *Hibbertia fumana*, *Acacia bynoeana*, *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora*. Survey methodology consisted of walking transects spaced 5 to 10 metres apart, with all observations recorded, counts of individual plants or stems taken, and GPS point locations captured. Surveys of *Grevillea parviflora* subsp. *parviflora* counted the number of stems, not individuals.

Targeted Koala and Cumberland Plain Land Snail surveys by Cumberland Ecology (Appendix B) in November and December 2018 were undertaken as follows:

- Rapid Spot Assessment Technique (SAT) surveys – surveys were undertaken in accordance with the methodology recommended by Phillips and Wallis (2016b) to detect signs of Koala activity across the study area. A total of 31 sites were established across the study area using a 250 metre sampling grid. Of these, a total of 16 sites were surveyed over one day on 30 November 2018. Surveys involved searching at the base of 5 - 7 Preferred Koala Feed Trees at each site for a maximum of 2 person minutes per tree to detect Koala faecal pellets (scats). Where scats were recorded using the Rapid SAT method, more comprehensive SAT surveys were undertaken using the methodology outlined by Phillips and Callaghan (2011) and in accordance with recommendations of the Commonwealth Koala Referral Guidelines (CoA 2014).
- Infra-red Cameras– A total of seven Infra-red (IR) motion/heat triggered cameras were deployed throughout the study area. Cameras were installed 30 November 2018 and collected 19 December 2018, resulting in a total of 19 days/nights of survey. Cameras were installed in areas with a high density of Preferred Koala Feed Trees or potential movement corridors for Koalas. Cameras were attached to trees approximately two metres high and facing a Preferred Koala Feed Tree where these were present.
- Koala detection dog – surveys were undertaken from 3 – 7 December 2018 by Cumberland Ecology ecologists and ReconEco handler/dog team. A trained detection dog was used to detect Koala scats throughout the study area. The detection dog was allowed to search off leash, and all movements by the detection dog during the survey were tracked using a GPS device. The locations of scats detected using this method were also recorded by GPS. A subset of scats detected using this method were sent to a scat identification specialist for further identify verification.
- Cumberland Plain Land Snail surveys – surveys were undertaken from 3 – 7 December 2018 concurrently with Koala detection dog surveys. Surveys were undertaken in accordance with the Environmental Impact Assessment Guidelines for Cumberland Plain Large Land Snail (NPWS 2000) and included habitat assessment in all areas searched by the detection dog. Searches for live Cumberland Plain Land Snail or empty shells were undertaken within one metre of the bases of trees greater than 10 centimetre diameter at breast height where suitable leaf litter was present.

The locations of supplementary targeted Koala and Cumberland Plain Land Snail surveys undertaken by Cumberland Ecology are shown in Figure 4-2. A full targeted Koala and Cumberland Plain Land Snail survey methodology is provided in Appendix B.

4.2.3 Identification of *Hibbertia* species

Targeted searches for threatened *Hibbertia* species within areas of suitable habitat were carried out following the discovery of *Hibbertia puberula* subsp. *puberula* (listed as Endangered under the TSC Act) and *Hibbertia fumana* (a species previously presumed to be extinct, and now provisionally listed as critically endangered under the TSC Act) on land east of Moorebank Avenue in late 2016.

Potential habitat for *Hibbertia puberula* subsp. *puberula* was identified on the Amended Proposal Site. Potential habitat for *Hibbertia fumana* does not appear to be present on the Amended Proposal Site; however, the species is associated with Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain (OEH, 2017), which has previously been mapped as occurring on the Amended Proposal Site. As a result, the abovementioned targeted searches for threatened plant species included both species of *Hibbertia*.

Targeted surveys were undertaken on 9 and 14 February 2017 and 14 March 2017, in the Amended Proposal Site. The surveys were undertaken via walking parallel transects spaced approximately 5 m apart in dense bushland, and approximately 10 metres apart in cleared areas and open grassland. Where threatened flora species were detected, the number of individuals was recorded and GPS point locations captured. Surveys of *Grevillea parviflora* subsp. *parviflora* counted the number of stems, not individuals.

The Amended Proposal Site was revisited on 3 and 16 November 2017. The identifications of *Hibbertia* spp. made in May 2017 were validated by the surveys carried out in November 2017, during the species' flowering period, in accordance with FBA requirements. The species was not in flower in the Amended Proposal Site during November surveys, but numerous plants were in bud and specimens were examined using a microscope to confirm their identification as *Hibbertia puberula* subsp. *puberula*.

4.2.4 Species polygons

Flora species polygons

Through consultation with OEH and DPE, it was determined an area of occupancy calculation methodology would be applied for *Hibbertia puberula* subsp. *puberula* and *Hibbertia fumana*. This was decided due to the inherent difficulties associated with accurately determining the population of *Hibbertia puberula* subsp. *puberula* and *Hibbertia fumana* based on a stem count. The area of occupancy approach would be used both in the assessment of impacts associated with the Moorebank Precinct, and the assessment of conservation areas (the biobank site) such that a consistent methodology is applied across the precinct.

Section 6.5.1 of the FBA outlines the methodology for preparing species polygons. Under section 6.5.1.17 of the FBA, a species polygon must use the unit of measurement ('count' or 'area') identified for that species in the Threatened Species Profile Database (now Threatened Species Data Collection). The Threatened Species Data Collection identifies *Hibbertia puberula* subsp. *puberula* as an 'area' species.

The Biodiversity Assessment Method 2016 (which generally does not apply to the MPW Stage 2 project) mandates the assessment of flora species using an area of

occupancy calculation for species listed as 'area' species in the Threatened Species Data Collection (OEH 2018).

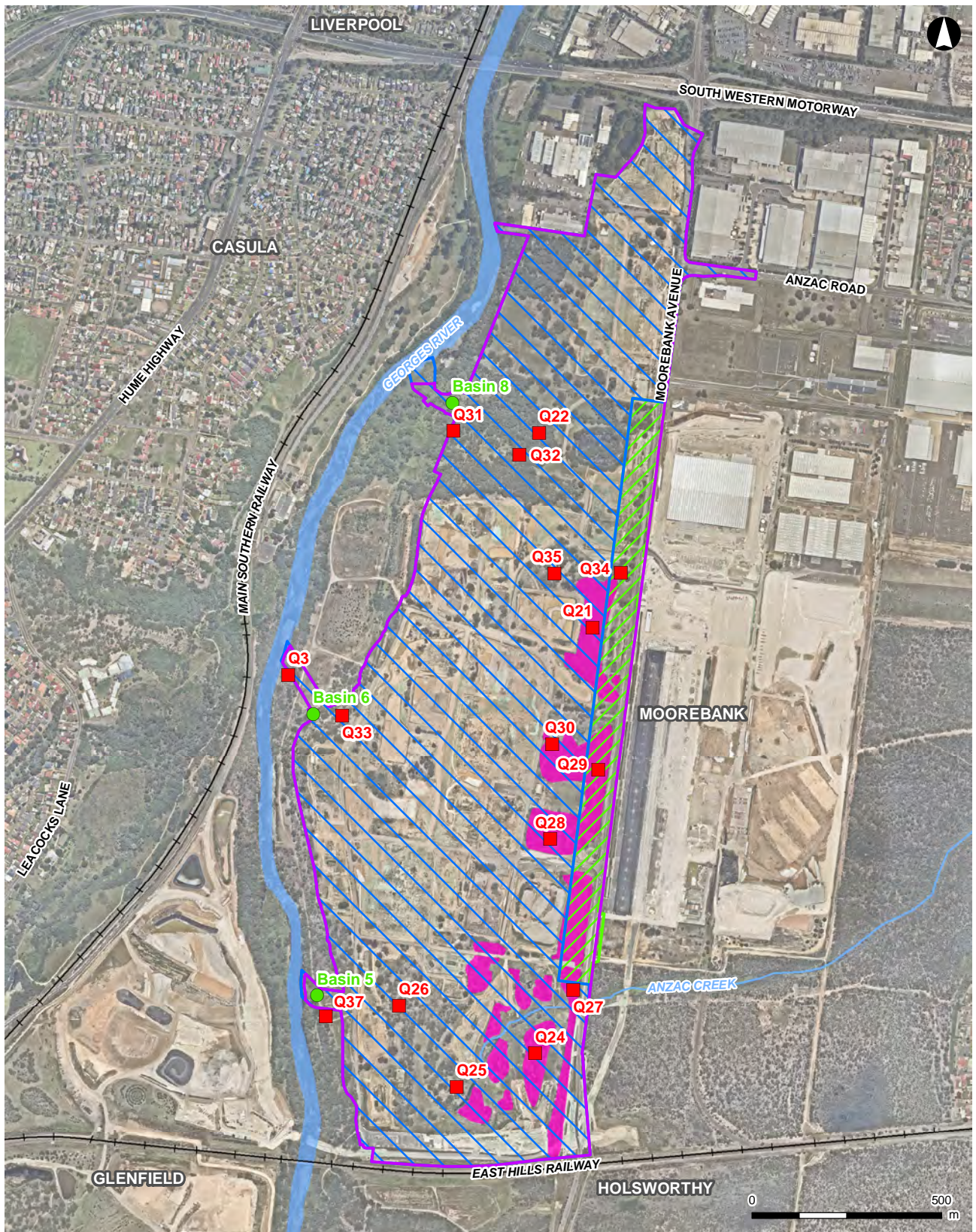
Section 6.4.1 of the BAM outlines that a species polygon must be prepared by creating a 30m buffer around the location of each identified individual and then combining these into a single area (species polygon). The assessment of the impacts of MPW Stage 2 on *Hibbertia puberula* subsp. *puberula* assessed in this BAR relate to impacts to the area of occupancy and not the number of stems. This approach has not been applied to *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* for two reasons: firstly, they are not subject to the same limitations in population assessment; secondly, offsets for EPBC Act listed threatened species within the precinct have been assessed and approved based on counts of individuals.

Fauna species polygons

The combined survey effort across the Amended Proposal Site was considered adequate to determine the presence/absence of Koalas and to identify the requirement to generate species polygons for the Koala.

Species polygons were created in accordance with section 6.5.1.17 of the FBA. In accordance with the Threatened Species Data Collection (OEH 2018) 'area' was used as the unit of measurement. The area of Koala habitat within the Amended Proposal Site was determined based on the following:

- Known Koala habitat was assumed to be present within all vegetation polygons where Koalas or Koala scats were recorded.
- In areas where scats were not recorded, Koala habitat was determined based on the presence of Koala 'use trees' as identified in *A review of koala tree use across New South Wales* (OEH 2018). Species identified as Koala use trees at the site include; *Eucalyptus tereticornis*, *Eucalyptus amplifolia*, *Eucalyptus parramattensis* and *Eucalyptus sclerophylla*. Koala habitat was therefore assumed to be present in all PCTs in which these tree species are dominant.
- The results of recent Koala studies undertaken by OEH indicate that all vegetation communities occurring on shale-influenced soils should be considered to represent 'high value habitat' for Koalas. All native vegetation communities occurring within the Amended Proposal Site are shale-influenced and are therefore considered to represent high value habitat for Koalas. All 'known' Koala habitat identified during surveys occurs within areas mapped as high value habitat.



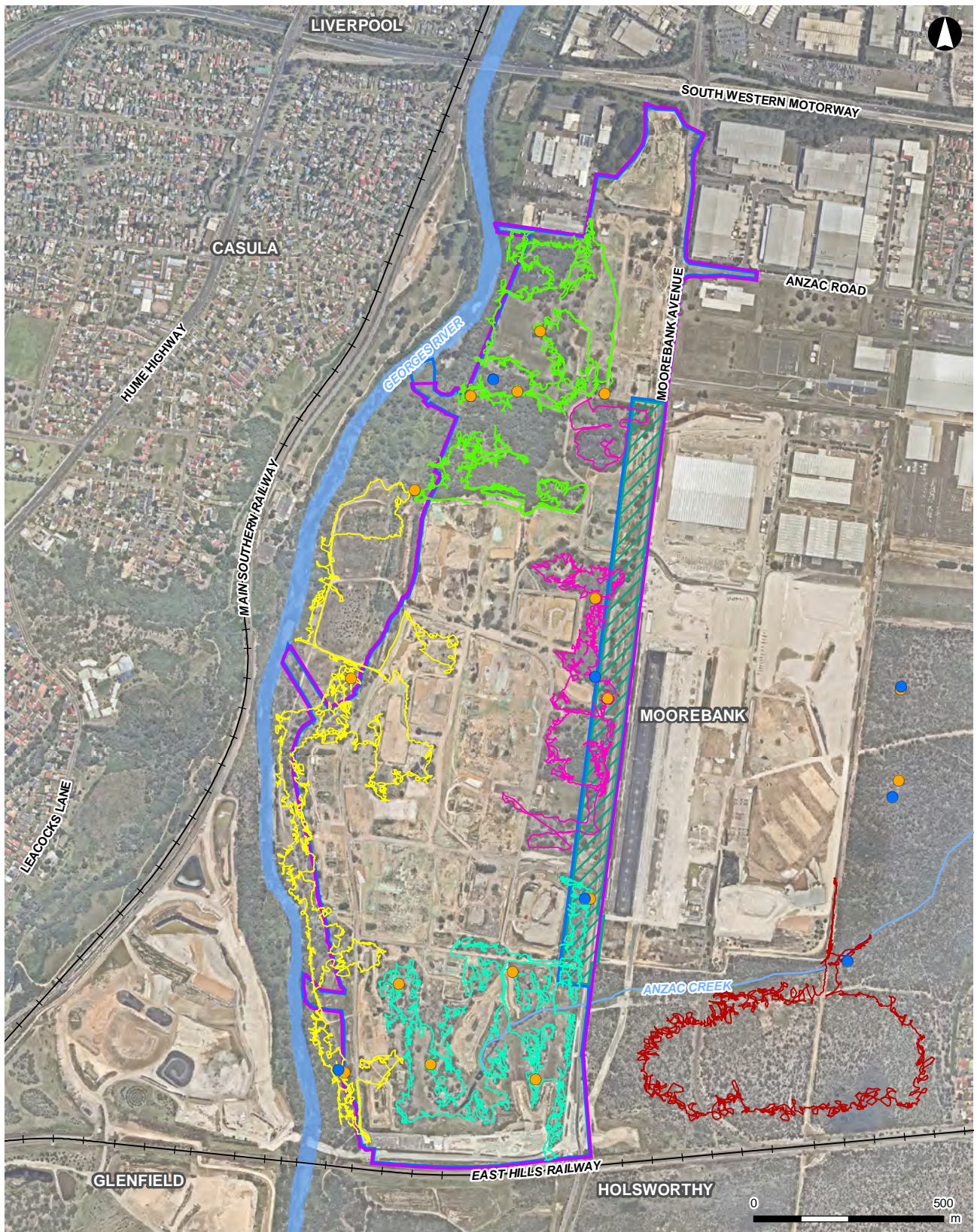
LEGEND

- | | |
|-----------------------|---|
| Amended Proposal site | Proposed outlet/drain inspection location |
| MPW Stage 2 site | Targeted threatened flora survey areas 2017 |
| Moorebank Avenue site | Existing railway |
| Biobanking plot | Watercourse |

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 Coordinate System: GDA 1994 MGA Zone 56
 Aerial imagery supplied by nearmap (Dec, 2018)



Figure 4-1 Vegetation sampling of the Amended Development Site



LEGEND

- | | |
|----------------------------|----------------------------|
| Amended Proposal site | Koala detection dog tracks |
| MPW Stage 2 site | Monday (3 Dec) |
| Moorebank Avenue site | Tuesday (4 Dec) |
| Rapid-SAT survey locations | Wednesday (5 Dec) |
| IR camera locations | Thursday (6 Dec) |
| Existing railway | Friday (7 Dec) |
| Watercourse | |

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Figure 4-2 Cumberland Ecology koala survey effort

5 LANDSCAPE ASSESSMENT

5.1 Landscape regions

Bioregions and landscapes associated with the Amended Proposal Site and outer assessment circle are mapped in Figure 5-1. The Amended Proposal Site is located within the Sydney Basin Bioregion and the Cumberland Subregion classified under the Interim Biogeographic Regionalisation for Australia (IBRA).

The MPW Site is located within the Sydney Metropolitan Major Catchment Area (MCA). The Amended Proposal Site is in the Cumberland IBRA subregion.

The Amended Proposal Site is located within the Georges River Alluvial Plain Mitchell landscape. This Mitchell Landscape is not currently listed in the credit calculator, so the Cumberland Plain Mitchell Landscape was used following advice from OEH (pers. comm. Biobanking Team, OEH, 25 August 2015).

5.2 Assessment circles

Two assessment circles were mapped to enable assessment of landscape values, including the percent current extent of native vegetation cover within and adjacent to the Amended Proposal Site. In accordance with the allowable combinations of inner and outer assessment circles in Table 8 of the FBA, an inner circle of 100 hectares and an outer circle of 1000 hectares were used. The 1,000 hectare circle was centred on the Amended Proposal Site and the 100 hectare circle was centred on the area of native vegetation that is most impacted by the Amended Proposal, as required in Appendix 4 of the FBA. The assessment circles are shown in Figure 5-1.

5.3 Rivers, streams and wetlands

The Amended Proposal Site is located within the Georges River catchment, which covers approximately 960 square kilometres and is managed by the Sydney Metropolitan Local Land Service. Georges River flows north along the western edge of the Amended Proposal Site, where it is considered to be a 6th order stream. The river is freshwater here, until it flows over the Liverpool Weir approximately 3.5 kilometres to the north. The weir, constructed in 1836, defines the upper reach of the Georges River estuary; below the weir the Georges River is influenced by tidal flows. The Georges River meanders south-east from Chipping Norton before draining into Botany Bay.

Anzac Creek originates from the MPW Site and extends to the north-east. The creek flows north past the adjoining suburbs of Wattle Grove and Moorebank before draining into Lake Moore in Chipping Norton, which flows into the Georges River. On the Amended Proposal Site, it is considered to be a 1st order stream. The section of Anzac Creek on the Amended Proposal Site is highly modified, located within cleared/disturbed lands within the former golf course.

In addition to these named watercourses, there is a formalised drainage channel located in the north of the Amended Proposal Site. The large open channel is concrete lined and conveys stormwater in a north-westerly direction across the MPW Site, discharging into the Georges River. Other hydrological features are restricted to constructed artificial wetlands and detention basins in the MPW Site.

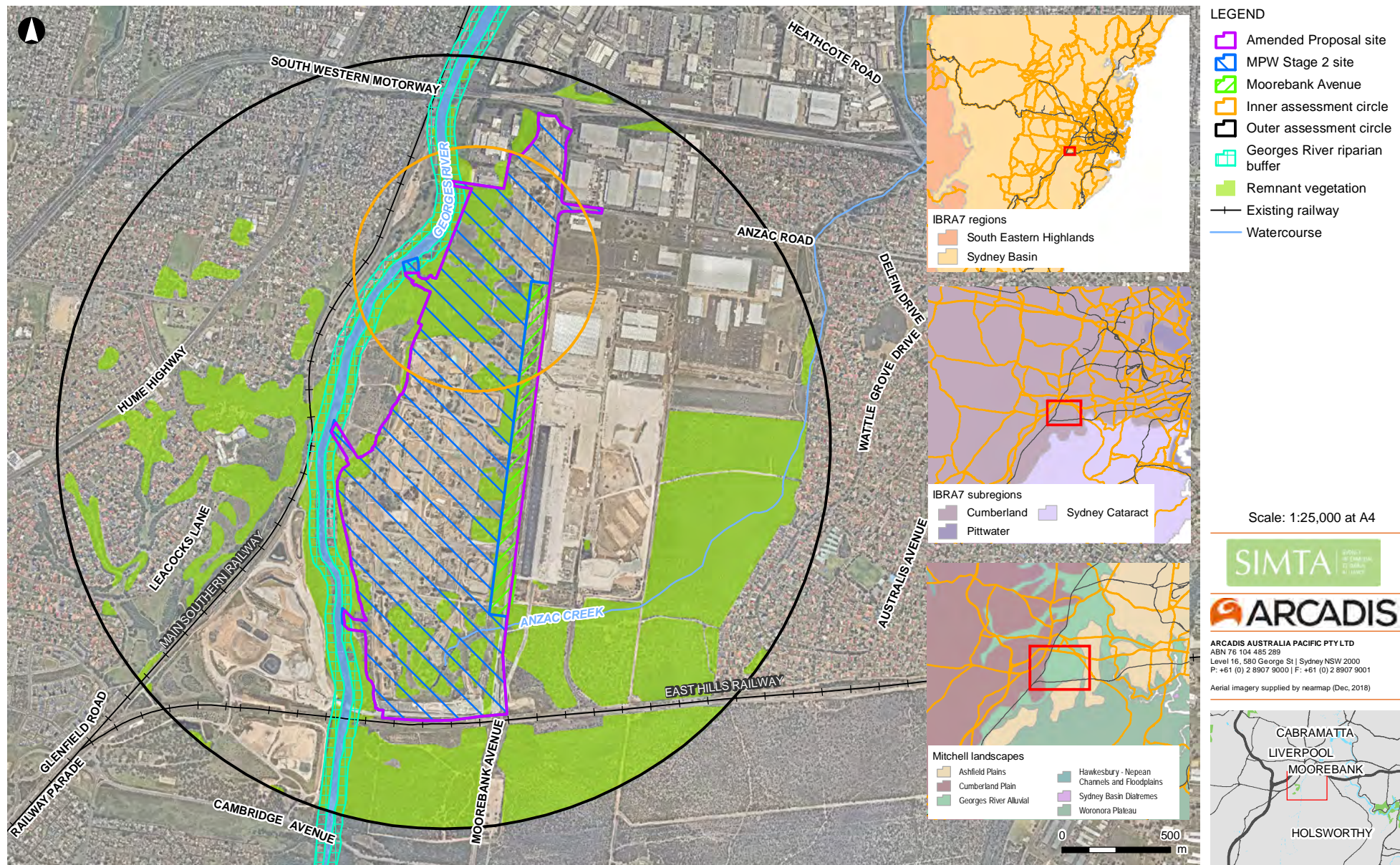


Figure 5-1 Landscape Assessment

A discussion of each of these determining factors in relation to the Amended Proposal Site is provided below.

5.3.1 Native vegetation cover in landscape

The native vegetation cover in the landscape was determined with reference to the regional vegetation mapping by NPWS (2002)/Tozer *et al.* (2003), updated with ground-truthed vegetation mapping within the MPW Stage 2 Site and in other parts of the Moorebank Precinct. All native vegetation types mapped within the inner and outer assessment circles were considered to represent the current native vegetation cover. The future native vegetation cover was determined by subtracting the area of native vegetation to be cleared for the Amended Proposal from the current summed native vegetation cover in each circle. Native vegetation cover percentages were calculated as a proportion of all land within each assessment circle that contains native vegetation.

The current and future percentage of native vegetation cover in the inner and outer assessment circles has been provided in Table 5-1. Scores for each percent cover were then determined using the score criteria in Table 9, Appendix 4 of the FBA.

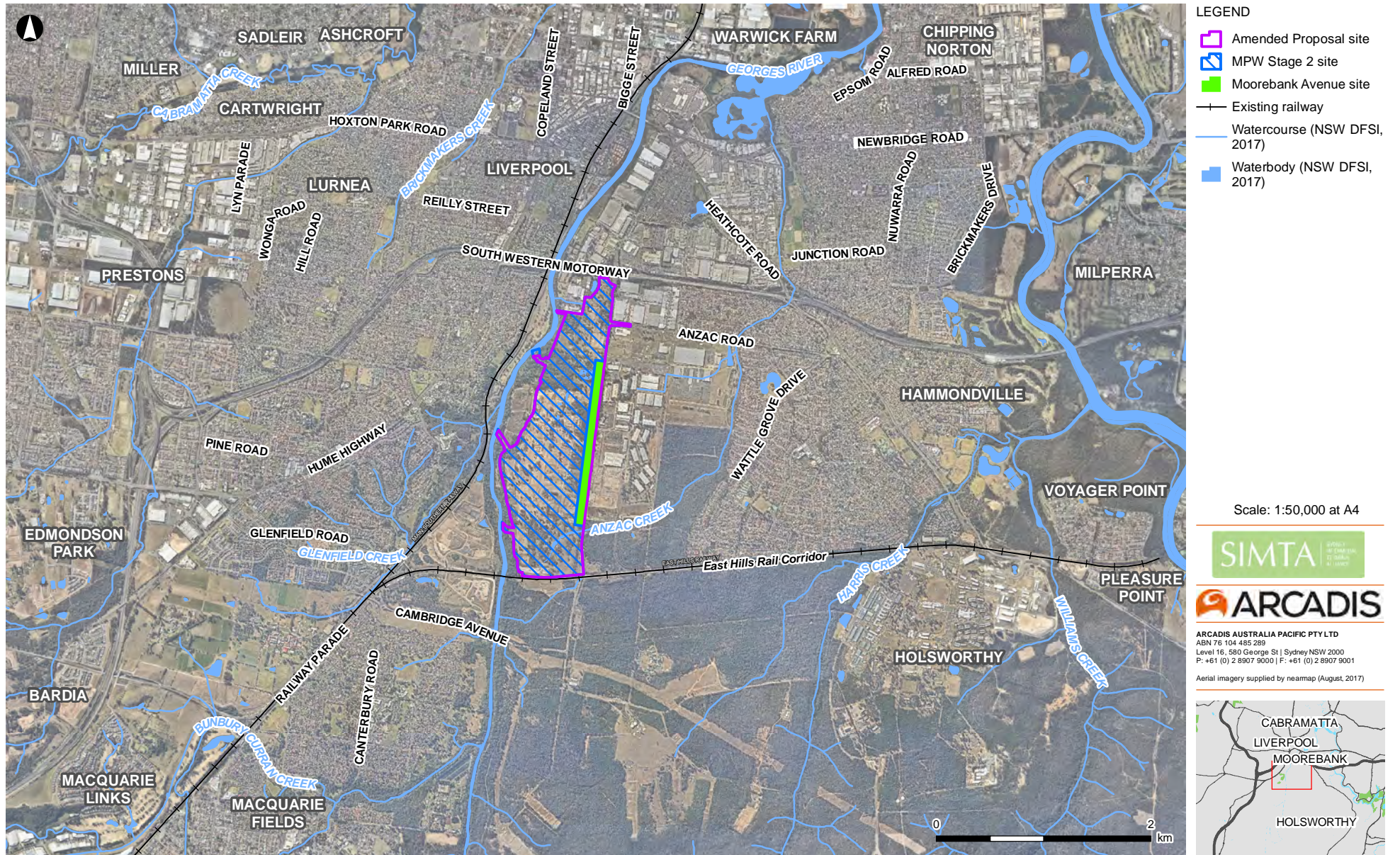


Figure 5-2 Watercourses and waterbodies

Table 5-1 Scores for the assessment of landscape value

| Criteria | Assessment Circle | % cover | Score |
|---------------------------------|-------------------------|---------|-------|
| Current native vegetation cover | Inner assessment circle | 25-30 | 4.5 |
| | Outer assessment circle | 26-30 | 7.5 |
| Future native vegetation cover | Inner assessment circle | 11-15 | 2.25 |
| | Outer assessment circle | 21-25 | 6.25 |

5.3.2 Connectivity value

The Amended Proposal includes construction of three stormwater basin outlets and a covered drain within the Georges River riparian zone, therefore impacts to this connecting link need to be considered in the current assessment. While it was identified in the MPW Concept Approval that stormwater overflows would be required from the site to the Georges River, assessment of these outlets was not included in PB (2015b) as the exact location of the channels had not been determined.

The Georges River is a 6th order stream and as such the riparian buffer 50 metres either side is considered to be a state significant biodiversity link in accordance with Table 10 of the FBA. This link is also shown in Figure 5-2. The corresponding connectivity value for the additional impact areas is 12. No further assessment of connectivity value is required for the assessment.

5.3.3 Patch size

The largest patch of native vegetation occurring in and adjacent to the MPW Stage 2 Site is the riparian corridor adjoining the Georges River, a portion of which is identified as the Moorebank Conservation Area. This vegetation connects to large areas of bushland in the Holsworthy Military Area to the south, which comprises approximately 18,000 hectares of continuous native vegetation. As such, the vegetation in the MPW Stage 2 Site has been assigned the maximum patch size of 1001 hectares. In accordance with the criteria in Table 15 of Appendix 4 of the FBA, the patch size class is considered to be *extra large* with a corresponding patch size score of 12.

6 NATIVE VEGETATION

6.1 Background

Vegetation within the Amended Proposal Site and locality has been mapped at the regional scale by the 'Native Vegetation of the Cumberland Plain, Western Sydney' and recent update (Tozer 2003). Field validation (ground-truthing) of the existing broad scale vegetation classification was undertaken to determine the vegetation structure, dominant canopy species, native diversity and condition.

6.2 Vegetation observations

The majority of the vegetation within the MPW Site consists of remnant forest and woodland vegetation that has been moderately modified as a result of:

- road infrastructure; e.g. Moorebank Avenue and the internal road network within the Defence land
- Defence infrastructure; e.g. internal road network, training grounds and buildings
- sewerage and stormwater infrastructure
- foot paths and fire trails within the vegetation remnants
- invasion by exotic species of plant such as *Lantana camara* (Lantana), *Tradescantia fluminensis* (Wandering Jew) *Ligustrum* spp. (Privets).

Nevertheless, there remain some areas that contain moderate to good condition remnant vegetation that is connected to larger areas of vegetation. Following site survey and ground-truthing, three vegetation types were identified within the Amended Proposal Site:

- MPW Stage 2 Site: three native vegetation communities (Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin, Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin and Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin).
- Moorebank Avenue Site: three native vegetation communities (Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland, Parramatta Red Gum Woodland, and Forest Red Gum – Rough-barked Apple Grassy Woodland) and one modified vegetation type, Planted and disturbed vegetation.

Given that the vegetation in the MPW Stage 2 Site is contiguous with that in the Moorebank Avenue Site, the vegetation of these areas is not described separately.

The vegetation within the Amended Proposal Site provides habitat for a large variety of flora and fauna species such as those being assessed as part of this FBA report. Detailed observations of the vegetation in the Amended Proposal Site are provided in PB (2014a, 2015b and c).

6.2.1 Planted and disturbed vegetation

Non-native and planted vegetation within the MPW Stage 2 Site is to be removed as part of the MPW Early Works.

The road reserve adjoining Moorebank Avenue is largely cleared, with closely mown grass on the verges. There were some planted trees in sections along the road edge, mainly native eucalypts species; commonly occurring species were *E. microcorys*, *E. saligna x botryoides*, *E. camaldulensis* and *E. tereticornis*. The trees ranged in height from 6 to 8 metres, and in diameter at breast height (dbh) from 0.1 to over one metre.

Most trees were in good health, although some had dead branches or had been pruned into poor shape.

6.2.2 Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland

Patches of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland occur in the east of the MPW Site, adjoining Moorebank Avenue. Parsons Brinckerhoff (2015a) described this community as subject to high disturbance from edge effects, existing roads, foot paths, golf course and weed invasion.

The canopy is dominated by native species including *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum), *Eucalyptus globoidea* (White Stringybark), *Eucalyptus parramattensis* subsp. *parramattensis* (Parramatta Red Gum) and *Melaleuca decora*. The shrub layer includes *Leucopogon juniperinus* (Prickly Beard-heath), *Pittosporum undulatum* (Sweet Pittosporum), *Acacia* spp., *Exocarpos cupressiformis* (Cherry Ballart), *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) and *Persoonia nutans* (Nodding Geebung). The groundcover is dominated by native species including *Microlaena stipoides* (Weeping grass), *Lomandra longifolia* (spiny-headed mat-rush), *Dianella revolute* (Blue Flax-Lily), *Poa affinis*, *Dichondra repens* (Kidney weed), and *Echinopogon ovatus* (Forest Hedgehog Grass) with scattered exotic species such as *Ehrharta erecta* (Panic Veldtgrass), *Lantana camara* (Lantana), *Asparagus asparagoides* (Bridal Creeper), *Senecio madagascariensis* (Fireweed), *Eragrostis curvula* (African lovegrass), *Chloris gayana* (Rhodes Grass), *Ligustrum sinense* (Small-leaved Privet) and *Olea europaea* subsp. *cuspidata* (African Olive) (Parsons Brinckerhoff 2015a).

6.2.3 Parramatta Red Gum woodland

Parramatta Red Gum Woodland occurs in the east of the Amended Proposal Site. Parsons Brinckerhoff (2015a) describe this community as subject to high disturbance from edge effects, existing roads, foot paths, former Department of Defence activities and weed invasion.

The canopy and shrub layer are dominated by native species including *Melaleuca linariifolia* (Flax-leaved Paperbark), *Casuarina glauca* (Swamp Oak) and *Leptospermum trinervium* (Flaky-barked Tea-tree). The groundcover is dominated by native species including *Pteridium esculentum* (Common Bracken), *Persicaria decipiens* (Slender knotweed), *Imperata cylindrica* (Blady Grass), *Gratiola pedunculata*, *Typha orientalis* (Broadleaf Cumbungi), *Baumea articulata* (Jointed Twig-rush), *Hydrocotyle verticillata* (Shield Pennywort) and *Euchiton sphaericus* with scattered exotic species such as *Rubus fruticosus* (Blackberry), *Ludwigia peruviana* (Peruvian Primrose), *Araujia sericifera* (Moth vine), *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) and *Paspalum urvillei* (Vasey Grass) (Parsons Brinckerhoff 2015a).

6.2.4 Forest Red Gum – Rough-barked Apple grassy woodland

The Forest Red Gum – Rough-barked Apple grassy woodland in the Amended Proposal Site occurs in patches across the western part of the Amended Proposal Site, and larger patches of this community adjoin the Georges River to the west. Parsons Brinckerhoff (2015a) describe this community as subject to high disturbance

from edge effects, existing roads, foot paths, former Department of Defence activities and weed invasion.

The canopy and shrub layer are dominated by native species including *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus amplifolia* (Cabbage Gum), *Angophora floribunda* (Rough-barked Apple), *Bursaria spinose* (Blackthorn, Boxthorn), *Breynia oblongifolia* (Coffee bush), *Leucopogon juniperinus* (Prickly Beard-heath), *Jacksonia scoparia* (Winged Broom-pea), *Acacia* spp., and *Exocarpos cupressiformis* (Cherry Ballart). The groundcover is dominated by native species including *Microlaena stipoides* (Weeping grass), *Lomandra longifolia* (Spiny-headed mat-rush), *Entolasia stricta* (Wiry panic), *Austrostipa ramosissima* (Stout Bamboo Grass), *Dianella revolute* (Blue Flax-Lily), *Themeda triandra* (Kangaroo grass), *Cynodon dactylon* (Couch), *Aristida ramosa* (Purple Wiregrass), *Carex appressa* (Tall sedge), *Dichondra repens* (Kidney weed) and *Oplismenus imbecillis* (Basket grass). Some areas within this community were dominated by an exotic shrub layer such as *Ehrharta erecta* (Panic Veldtgrass), *Ligustrum* spp., *Olea europaea* subsp. *cuspidate* (African Olive) and *Lantana camara* (Lantana) (Parsons Brinckerhoff (2015a).

6.2.5 Additional areas of impact

In addition to the site assessment and vegetation mapping undertaken by PB (2014a, 2015b and c), vegetation observations were made on the Amended Proposal Site by Arcadis ecologists Jane Rodd and Laura Hoffman in March 2016, focusing on additional areas of impact outside the area approved for the MPW Concept Approval. The areas of the proposed sediment basin outfall channels and covered drain were inspected, as shown on Figure 8-1.

Basin 5 Outlet

The proposed basin 5 outlet was largely inaccessible due to the steep slope in the east of the section and dense cover of *Lantana camara* in the midstorey. The proposed channel is in the location of an existing major channel draining the north of the MPW Site; the existing drainage infrastructure in this location has collapsed, leaving uncontrolled flows and substantial erosion channels running down the slope.

The vegetation in the proposed area of impact is highly modified; scattered *Eucalyptus tereticornis* (Forest Red Gum) were observed on the slope, with a dense midlayer of *Lantana camara* (Lantana) and *Ligustrum* spp. (Privets). Access to the lower slope was obstructed, so it could not be inspected.



Vegetation downslope of existing drain in basin 5 Outlet



Existing damaged/collapsed drainage structure

Basin 6 Outlet

This outlet intersects the former plant and equipment operation training area, known as the 'dust bowl', which is currently cleared of native vegetation and dominated by exotic grassland. There is a band of native vegetation mapped in the south-east of the outlet area; this is mainly comprised of *Acacia binervia* (Coast Myall) with an exotic-dominated understorey including *Lantana camara*, *Jacaranda mimosifolia* (Jacaranda) and *Olea europaea* subsp. *cuspidata* (African Olive).

The basin 6 outlet also intersects riparian vegetation adjoining the Georges River. In this location, the vegetation is characterised by a sparse canopy dominated by *Eucalyptus botryoides* x *saligna* and *Angophora subvelutina* (Broad-leaved Apple) and a midstorey dominated by native shrubs including *Acacia binervia*, *Acacia decurrens* (Black Wattle), *Glochidion ferdinandi* (Cheese Tree) and *Kunzea ambigua* (Tick Bush). The ground layer vegetation is sparse and dominated by the native grass *Microlaena stipoides* (Weeping Grass). There is variable abundance and cover of exotic species in this area, with higher exotic occurrence closer to the river, where *Lantana camara*, *Olea europaea* subsp. *cuspidata* and *Ligustrum* spp. frequently occur.



Vegetation in south-east of basin 6 outlet area Riparian vegetation adjoining Georges River

Basin 8 Outlet

The proposed basin 8 outlet crosses areas of cleared grassland in the east, with scattered trees and a wide, gravel-covered track. In the west of this area there is degraded riparian forest, with a canopy of *Eucalyptus botryoides* x *saligna* and a dense understorey of weeds including *Lantana camara*, *Arundo donax* (Giant Reed), *Ligustrum* spp., *Cardiospermum grandiflorum* (Balloon Vine), *Bidens pilosa* (Cobblers Pegs) and *Eragrostis curvula* (African Lovegrass). There was low occurrence of native understorey species, with some *Pteridium esculentum* (Bracken), *Acacia binervia* and *Melicytus dentatus* (Tree Violet) observed in the northern part of the basin outlet area.



Cleared areas in eastern part of basin 8 outlet



Riparian vegetation adjoining the Georges River in basin 8 outlet

Covered drain in Endeavour Energy easement

The Endeavour Energy easement is largely cleared of native vegetation and supports a regularly mown/slashed grassland. At the western end of the easement is a steep, eroded slope supporting scattered native trees and shrubs. It is adjoined to the south by native vegetation in moderate condition with a canopy of *Eucalyptus tereticornis* (Forest Red Gum) and a dense shrub layer dominated by *Acacia* spp. and a sparse grassy groundlayer. There are numerous stands of *Lantana camara* interspersed in the native vegetation.

6.3 Plant Community Types

The vegetation within the Amended Proposal Site consists predominantly of remnant and regrowth vegetation that has been subject to weed invasion in some areas. Most of the vegetation within the larger MPW Site is native and representative of endangered ecological communities listed in Schedule 1 and 2 of the TSC Act.

Four Plant Community Types (PCTs) were identified by PB (2014a) following review of existing regional mapping (NPWS 2002/Tozer 2003), soil and geology attributes, landscape position and structural and floristic attributes recorded during site assessments (refer to Table 6-1 and Figure 6-1). The PCTs are described in detail in PB (2014a).

Table 6-1 Plant community types (PCTs) identified by PB (2014a) on the MPW Concept Approval Development Site

| Vegetation Class (Keith 2004) | PCT ID | Plant Community Type | Estimated clearance of PCT since European settlement | Area (ha) in MPW Concept development site |
|---|--------|---|--|---|
| Sydney Sand Flats Dry Sclerophyll Forests | ME003 | Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin | 50% | 16.1 |
| Cumberland Dry Sclerophyll Forests | ME005 | Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | 45% | 0.9 |

| Vegetation Class (Keith 2004) | PCT ID | Plant Community Type | Estimated clearance of PCT since European settlement | Area (ha) in MPW Concept development site |
|-------------------------------------|--------|---|--|---|
| Coastal Valley Grassy Woodlands | ME018 | Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | 95% | 28.1 |
| North Coast Wet Sclerophyll Forests | ME044 | Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin | 45% | 3.6 |

PB (2014a) mapped Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin along the Georges River riparian corridor. This PCT is equivalent to Warm Temperate Layered Forest (Tozer *et al.* 2006), wet sclerophyll forest with a moist shrubby understorey which occurs predominantly south of the Hacking River along the Illawarra scarp, to Nowra and throughout the Kangaroo Valley. The vegetation mapping of the Sydney Metro Catchment Management Authority (CMA) area (DECCW 2009), which the Amended Proposal Site falls within, mapped the areas of Warm Temperate Layered Forest within the Royal National Park as Illawarra Escarpment Blue Gum Wet Forest.

In the Sydney Metro CMA vegetation mapping of the Amended Proposal Site and surrounds, this section of the Georges River riparian corridor is mapped as Hinterland Flats Eucalypt Forest (map unit S_FoW09), which is referenced as being a component of Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (DECCW 2009). This community was considered to be a better fit for the vegetation on the MPW Site and more consistent with regional vegetation mapping and classifications, therefore areas within the Amended Proposal Site previously mapped as Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin were reclassified as Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin in the current assessment.

The updated Sydney Metro CMA mapping (OEH 2016) identifies Hinterland Riverflat Eucalypt Forest (S_FoW09) as corresponding to PCT 941: Mountain Blue Gum – Thin-leaved Stringybark Open Forest on River-flat Alluvium in the Burragorang Valley, Sydney Basin. The description of Hinterland Riverflat Eucalypt Forest notes that this vegetation type is closely related to riverflat forests found on the Cumberland Plain and nearby on the Georges River, including Cumberland Riverflat Forest (S_FoW06); the Cumberland forests (S_FoW06) are stated to have fewer mesic small trees and shrubs and a different combination of tree species. Hinterland Riverflat Eucalypt Forest grades into Cumberland Riverflat Forest (S_FoW06) at elevations below eight metres above sea level and on broader floodplains. Based on the descriptions in OEH (2016), the vegetation on the MPW Site is likely to fall near the distributional transition between Hinterland Riverflat Eucalypt Forest and Cumberland Riverflat Forest, and shares some of the floristic characteristics of Hinterland Riverflat Eucalypt Forest.

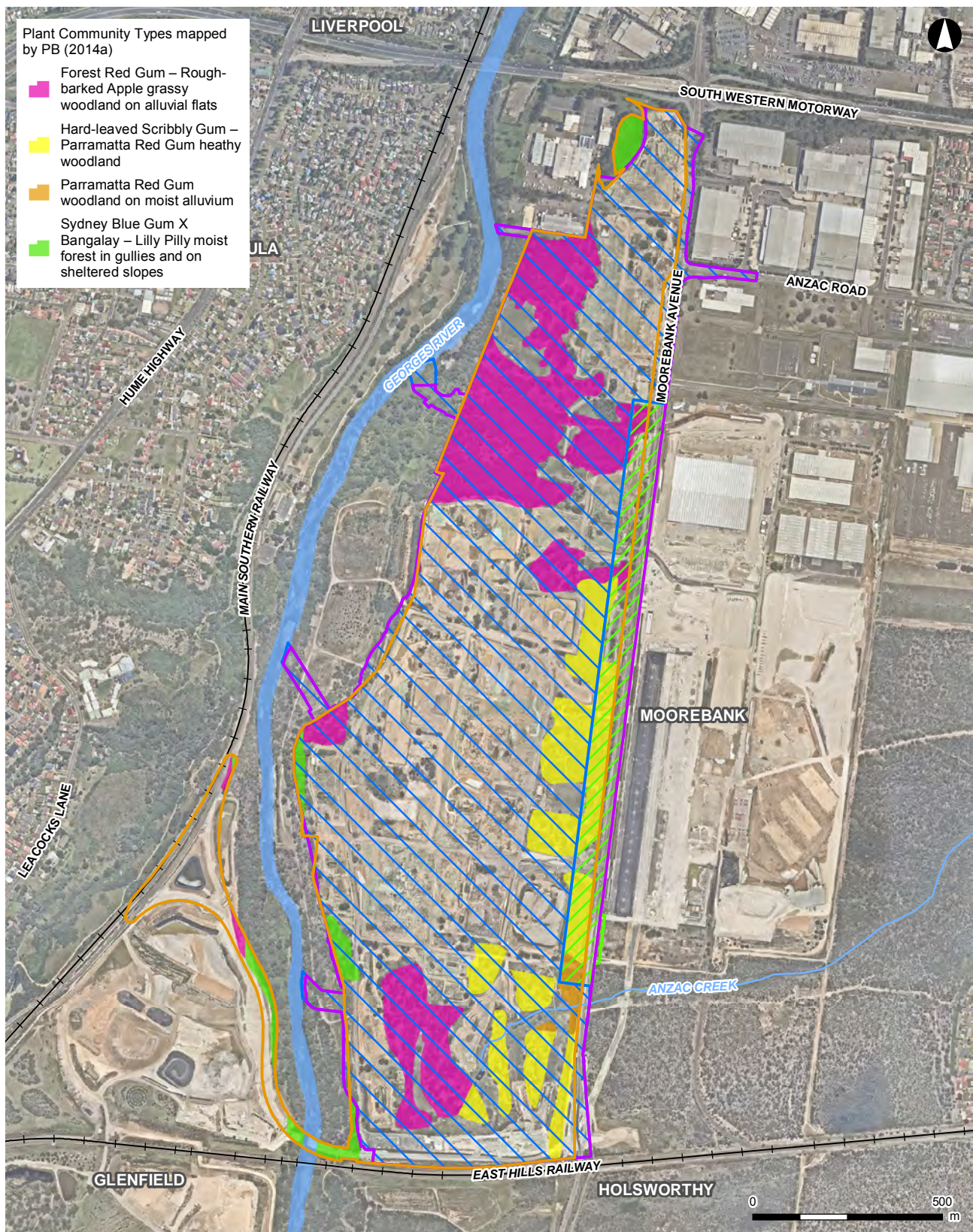


Figure 6-1 PB (2014a) mapped Plant Community Types (PCTs) on the MPW Concept Development Site

The justification for the identification of PCTs in the current assessment is provided below in Table 6-2:

Table 6-2 Justification for identification of PCTs on the Amended Proposal Site

| Plant Community Type | Species relied upon for ID of PCT | Justification of evidence used to identify a PCT |
|---|--|--|
| Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (PCT 883) | <i>Eucalyptus sclerophylla</i> <i>Eucalyptus parramattensis</i> | Previous regional mapping as an equivalent vegetation type Landscape position Characteristic tree species present Structure and species composition is consistent with descriptions in VIS database and published references. |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (PCT 1067) | <i>Melaleuca linariifolia</i> | Previous regional mapping as an equivalent vegetation type Landscape position Characteristic tree species present Structure and species composition is consistent with descriptions in VIS database and published references. |
| Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (PCT 835) | <i>Eucalyptus tereticornis</i> <i>Eucalyptus amplifolia</i> <i>Angophora subvelutina</i> <i>Angophora floribunda</i> <i>Eucalyptus saligna</i> x <i>botryoides</i> | Previous regional mapping as an equivalent vegetation type Landscape position Characteristic tree species present Structure and species composition is consistent with descriptions in VIS database and published references. |

Further quantitative analysis of the vegetation quadrat data was undertaken to test the justifications for assigning PCTs. The vegetation data was compared with the lists of positive diagnostic species for communities mapped within and adjacent to the Amended Proposal Site, as specified in OEH (2016). The descriptions and lists of positive diagnostic species for equivalent vegetation communities in Tozer *et al.* (2010), which are generally referenced in the PCT scientific descriptions in the Bionet Vegetation Classification Database, were also analysed. The equivalent vegetation communities for each PCT are listed in Table 6-3.

Table 6-3 PCTs that were considered to potentially occur in or adjacent to the Amended Proposal Site

| Plant Community Type | Equivalent OEH (2016) vegetation community | Equivalent Tozer et al. (2010) vegetation community |
|---|---|--|
| Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (PCT 883) | S_DSF19: Castlereagh Scribbly Gum Woodland | DSF p7: Castlereagh Scribbly Gum Woodland |
| Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (PCT 724) | S_DSF02: Castlereagh Shale-Gravel Transition Forest | DSF p502: Castlereagh Shale-Gravel Transition Forest |
| Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (PCT 725) | S_DSF01: Castlereagh Ironbark Forest | DSF p1: Castlereagh Ironbark Forest |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (PCT 1067) | S_DSF20: Castlereagh Swamp Woodland | DSF p4: Castlereagh Swamp Woodland |
| Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (PCT 835) | S_FoW06: Cumberland Riverflat Forest | FoW p33: Cumberland River Flat Forest |
| Mountain Blue Gum - Thin-leaved Stringybark open forest on river flat alluvium in the Sydney Basin Bioregion (PCT 941) | S_FoW09: Hinterland Riverflat Eucalypt Forest | FoW p31: Burragorang River Flat Forest |

For each vegetation community, the minimum number of positive diagnostic species expected to be recorded in a sample site has been calculated (OEH 2016). The presence of the minimum number of positive diagnostic species in a sample site is strong evidence that the sample belongs to the vegetation community. It is necessary for identification using this method that the total number of native species recorded in the sample site exceeds a specified minimum; species-poor sites cannot be tested (OEH 2016). As can be seen in Table 6-4 and Table 6-5, low species counts in the quadrats meant that the vegetation cannot be reliably be identified using analysis of positive diagnostic species.

Table 6-4 Comparison of quadrat data collected in Dry Sclerophyll forest with positive diagnostic species for OEH (2016) and Tozer et al. (2010)

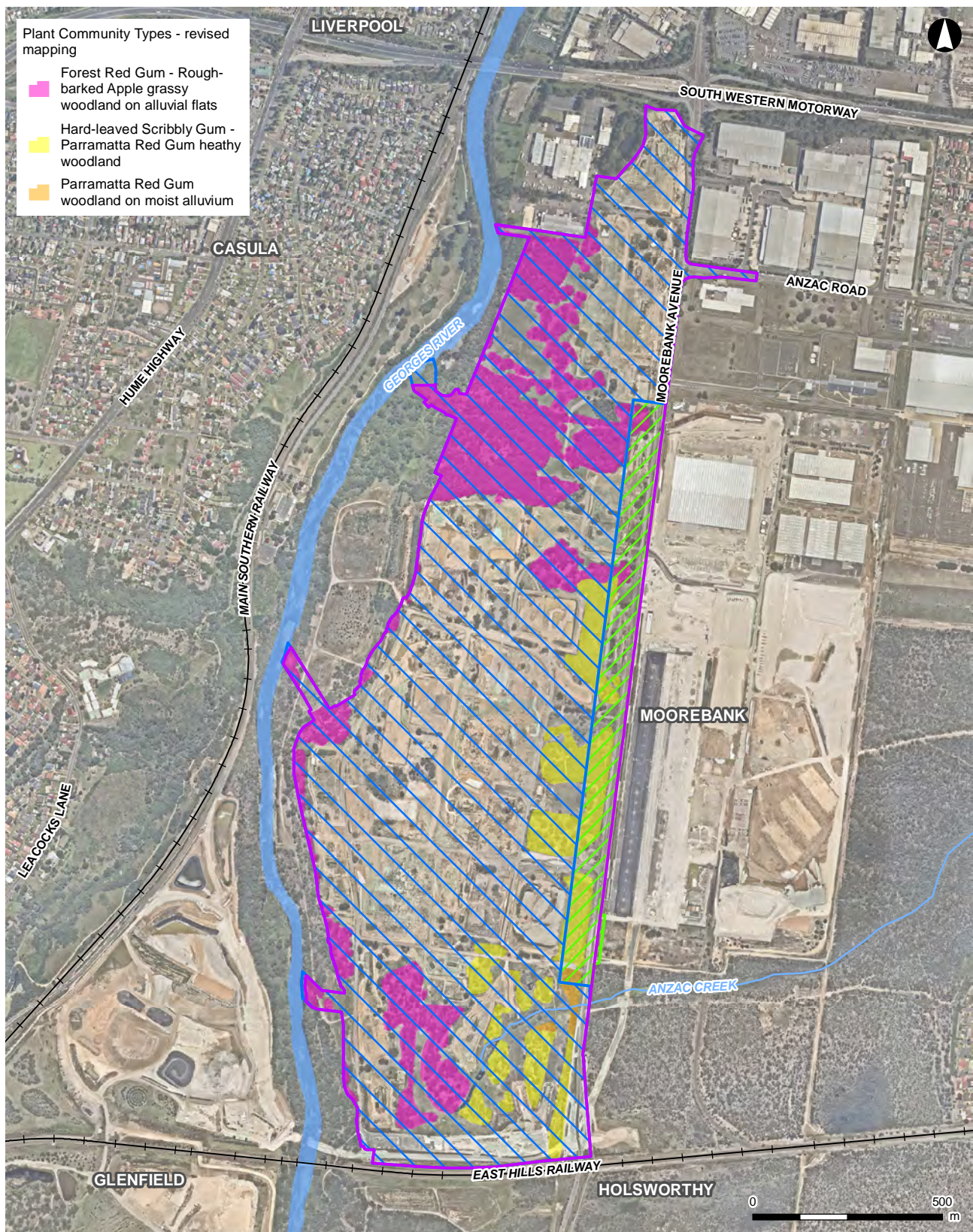
| Quadrat | Native species | Plant Community Type | | | | | | | |
|--|----------------|----------------------|---------------|-------------|-----------------|-------------|---------------|-------------|---------------|
| | | PCT 883 | | PCT 724 | | PCT 725 | | PCT 1067 | |
| | | DSF19 (OEH) | DSFp7 (Tozer) | DSF02 (OEH) | DSFp502 (Tozer) | DSF01 (OEH) | DSFp1 (Tozer) | DSF20 (OEH) | DSFp4 (Tozer) |
| Minimum native species required | | 37 | 43 | 28 | 37 | 35 | 35 | 18 | 37 |
| Minimum positive diagnostic species required | | 21 | 30 | 13 | 25 | 20 | 21 | 6 | 19 |
| Q21 | 32 | 15 | 10 | 10 | 11 | 12 | 14 | 8 | 7 |
| Q24 | 12 | 5 | 8 | 7 | 8 | 7 | 8 | 3 | 4 |
| Q28 | 24 | 11 | 11 | 12 | 13 | 13 | 13 | 5 | 5 |
| Q29 | 21 | 11 | 9 | 10 | 11 | 11 | 12 | 4 | 4 |
| Q30 | 6 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 0 |
| Q33 | 27 | 10 | 9 | 15 | 15 | 17 | 15 | 5 | 5 |
| Q27 | 13 | 2 | 1 | 1 | 2 | 0 | 0 | 4 | 4 |

Table 6-5 Comparison of quadrat data collected in Forested Woodlands with positive diagnostic species for OEH (2016) and Tozer et al. (2010)

| Quadrat | Native species | Plant Community Types | | | |
|--|----------------|-----------------------|----------------|-------------|----------------|
| | | PCT 835 | | PCT 941 | |
| | | FoW06 (OEH) | FoWp33 (Tozer) | FoW09 (OEH) | FoWp31 (Tozer) |
| Minimum native species required | | 22 | 35 | 24 | 26 |
| Minimum positive diagnostic species required | | 10 | 12 | 7 | 16 |
| Q22 | 10 | 6 | 7 | 1 | 1 |
| Q23 | 8 | 4 | 6 | 3 | 3 |
| Q25 | 11 | 7 | 8 | 5 | 4 |
| Q26 | 25 | 7 | 9 | 6 | 6 |
| Q31 | 2 | 0 | 0 | 2 | 1 |
| Q32 | 3 | 1 | 2 | 1 | 2 |
| Q34 | 4 | 2 | 2 | 0 | 1 |
| Q35 | 16 | 9 | 12 | 6 | 5 |

During surveys in February and March 2017, it was noted that some areas previously mapped as native vegetation were actually areas of planted trees, hardstand and buildings and mown, exotic-dominated ground layer including golfing greens. As such, the vegetation mapping has been revised, based on site inspection and aerial photo interpretation, to remove cleared areas and planted trees.

The revised PCTs identified within the Amended Proposal Site are presented in Table 6-6 and shown in Figure 6-2.



LEGEND

- Amended Proposal site
- MPW Stage 2 site
- Moorebank Avenue site
- Existing railway
- Watercourse

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 Aerial imagery supplied by nearmap (Dec. 2018)

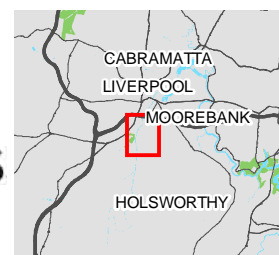


Figure 6-2 Revised mapping of Plant Community Types (PCTs) on the Amended Development Site

Table 6-6 Revised PCTs in Amended Proposal Site

| Vegetation Class (Keith 2004) | PCT ID | Plant Community Type | Estimated clearance of PCT since European settlement | Area (ha) within Amended Proposal Site |
|---|--------|---|--|--|
| MPW Stage 2 Site | | | | |
| Sydney Sand Flats Dry Sclerophyll Forests | ME003 | Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin | 50% | 9.81 ha |
| Sydney Sand Flats Dry Sclerophyll Forests | ME005 | Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | 45% | 0.46 ha |
| Coastal Floodplain Wetlands | ME018 | Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | 95% | 27.88 ha |
| Moorebank Avenue Site | | | | |
| Sydney Sand Flats Dry Sclerophyll Forests | ME003 | Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin | 50% | 3.73 ha |
| Sydney Sand Flats Dry Sclerophyll Forests | ME005 | Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | 45% | 0.22 ha |
| Coastal Floodplain Wetlands | ME018 | Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | 95% | 0.59 ha |

6.3.1 Threatened Ecological Communities

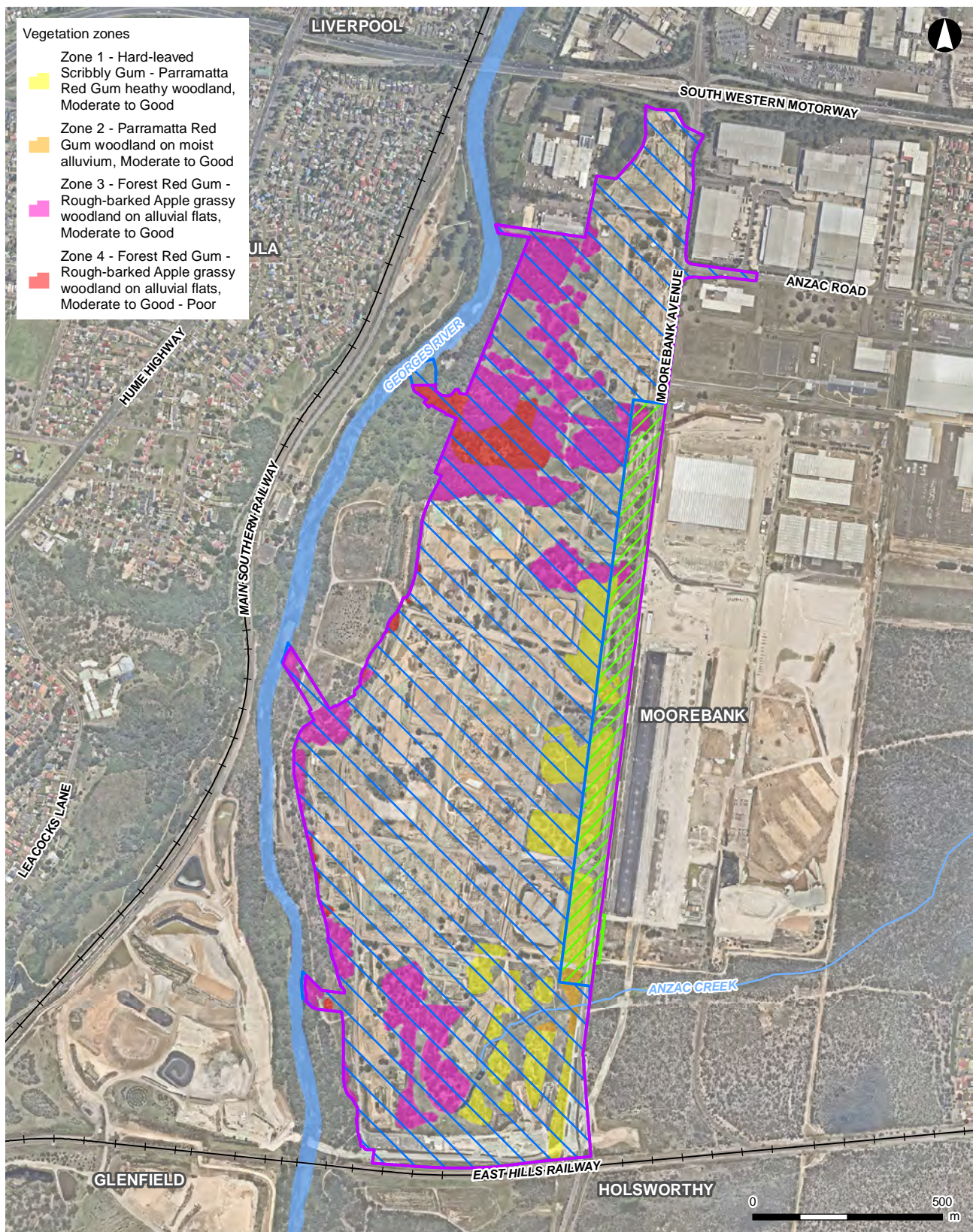
The three PCTs identified in the Amended Proposal Site fall within the definitions of threatened ecological communities listed under the TSC Act and/or EPBC Act, as per Table 6-7.

Table 6-7 Threatened ecological communities on the Amended Proposal Site

| Plant Community Type | Equivalent TEC | TSC Act Status | EPBC Act Status |
|---|---|----------------|-----------------|
| MPW Stage 2 Site | | | |
| Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin | Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion | Vulnerable | Endangered |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | Castlereagh Swamp Woodland | Endangered | Not listed |
| Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions | Endangered | Not listed |
| Moorebank Avenue Site | | | |
| Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003) | Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion | Vulnerable | Endangered |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | Castlereagh Swamp Woodland | Endangered | Not listed |
| Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions | Endangered | Not listed |

6.4 Vegetation zones

The Amended Proposal Site contained three distinct vegetation types in the moderate to good condition category. The vegetation zones within the Amended Proposal Site are shown in Figure 6-3 and summarised in Table 6-8. Two condition classes have been delineated within ME018 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good, and Moderate/Good – Poor. This is to account for the areas within this vegetation type with a reduced or absent understorey, often dominated by exotic grasses or herbs, and significant amounts of invasive exotic species such as *Lantana camara*, *Ligustrum* spp. and *Cardiospermum grandiflorum* in the midlayer. The primary area of this vegetation zone is located around the existing drain in the north-west of the Amended Proposal Site.



LEGEND

- Amended Proposal site
- MPW Stage 2 site
- Moorebank Avenue site
- Existing railway
- Watercourse

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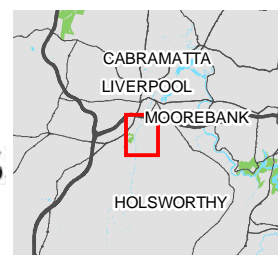


Figure 6-3 Vegetation zones on the Amended Development Site

Table 6-8 Vegetation zones on the Amended Proposal Site

| Vegetation zone | 1 | 2 | 3 | 4 |
|-------------------------|--|---|---|---|
| MPW Stage 2 Site | | | | |
| Vegetation class | Dry Sclerophyll forests (Shrub/grass) | Dry Sclerophyll forests (Shrub/grass) | Grassy Woodlands | Grassy Woodlands |
| Biometric code | ME003 | ME005 | ME018 | ME018 |
| PCT name | Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain | Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin |
| Condition class | Moderate/Good | Moderate/Good | Moderate/Good - Medium | Moderate/Good - Poor |
| Area (ha) | 9.81 | 0.46 | 23.94 | 3.94 |
| Plots | <ul style="list-style-type: none"> • Q21 • Q24 • Q28 • Q30 | <ul style="list-style-type: none"> • Q27 | <ul style="list-style-type: none"> • Q3 • Q22 • Q23 • Q25 • Q26 • Q33 • Q35 • Q37 | <ul style="list-style-type: none"> • Q31 • Q32 |

| Vegetation zone | 5 | 6 | 7 | N/A |
|-----------------|---|---|---|-----|
|-----------------|---|---|---|-----|

Moorebank Avenue Site

| | | | | |
|------------------|---------------------------------------|---------------------------------------|------------------|-----|
| Vegetation class | Dry Sclerophyll forests (Shrub/grass) | Dry Sclerophyll forests (Shrub/grass) | Grassy Woodlands | N/A |
| Biometric code | ME003 | ME005 | ME018 | |

| Vegetation zone | 5 | 6 | 7 | N/A |
|-----------------|---|---|---|-----|
| PCT name | Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin | Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | |
| Condition class | Moderate/Good | Moderate/Good | Moderate/Good - Medium | |
| Area (ha) | 3.73 | 0.22 | 0.59 | |
| Plots | • Q21 • Q29 | • Q27 | • Q34 | |

6.5 Site value scores for vegetation zones

The site value score for each vegetation zone identified in the Amended Proposal Site was determined through assessment of site attribute data collected in vegetation plots. The site attribute data entered into the credit calculator for the current assessment is sourced from PB (2015a, 2015b, 2015c), and is shown in Table 6-9.

Table 6-9 Quadrat data from the Amended Proposal Site

| Plot Name | Site attributes | | | | | | | | | |
|---|-----------------|--------------|--------------|--------------|-------------|--------------|----------|----------|----|-----------|
| | NPS | NOS | NMS | NGC G | NGC S | NGC O | EPC | NTH | OR | FL |
| ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good | | | | | | | | | | |
| Bench-mark | 40 | 10-20 | 23-33 | 12-24 | 0-10 | 12-24 | - | 1 | | 30 |
| Q21 | 33 | 22 | 18 | 44 | 2 | 22 | 0 | 0 | 1 | 2 |
| Q24 | 8 | 24 | 1.5 | 72 | 0 | 0 | 2 | 1 | 1 | 0 |
| Q28 | 21 | 15.5 | 26 | 40 | 18 | 24 | 4 | 0 | 1 | 1 |
| Q29 | 7 | 13 | 3 | 16 | 0 | 2 | 62 | 0 | 1 | 4 |
| Q30 | 12 | 14 | 1 | 28 | 0 | 0* | 6 | 0 | 1 | 0 |

| Plot Name | Site attributes | | | | | | | | | |
|-----------|-----------------|-----|-----|-------|-------|-------|-----|-----|----|----|
| | NPS | NOS | NMS | NGC G | NGC S | NGC O | EPC | NTH | OR | FL |

ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good

| Bench-mark | 36 | 6.5-41.5 | 5-25 | 12.2-38.2 | 0-10 | 12.2-38.2 | - | 0 | | 0 |
|------------|----|----------|------|-----------|------|-----------|---|---|---|---|
| Q27 | 12 | 35 | 0 | 0 | 0 | 52 | 0 | 0 | 1 | 4 |

ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good

| Bench-mark | 16 | 15-44 | 4-34 | 32-82 | 8-37 | 32-82 | - | 1 | 1 | >30 |
|------------|----|-------|------|-------|------|-------|----|---|---|-----|
| Q3 | 20 | 27 | 17.5 | 60 | 0 | 0 | 14 | 0 | 1 | 21 |
| Q22 | 9 | 17.5 | 0.5 | 20 | 0 | 50 | 6 | 0 | 1 | 0 |
| Q25 | 10 | 30 | 0 | 50 | 0 | 2 | 20 | 0 | 1 | 0 |
| Q26 | 21 | 20 | 15 | 62 | 8 | 12 | 0 | 0 | 1 | 4 |
| Q33 | 26 | 26 | 5.5 | 52 | 2 | 18 | 44 | 0 | 1 | 0 |
| Q34 | 4 | 15 | 0 | 32 | 0 | 0 | 8 | 0 | 1 | 0 |
| Q35 | 14 | 24 | 0.5 | 32 | 0 | 8 | 12 | 0 | 1 | 0 |
| Q37 | 6 | 11.1 | 0.5 | 6 | 6 | 0 | 34 | 0 | 0 | 1 |

ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good - Poor

| Bench-mark | 16 | 15-44 | 4-34 | 32-82 | 8-37 | 32-82 | - | 1 | 1 | >30 |
|------------|----|-------|------|-------|------|-------|----|---|---|-----|
| Q31 | 2 | 22 | 0 | 20 | 0 | 0 | 80 | 0 | 1 | 0 |
| Q32 | 2 | 31 | 0 | 0 | 2 | 0 | 70 | 0 | 1 | 0 |

Key to site attributes

| | |
|------------------------------------|------------------------------------|
| NPS = Native plant species | NGCO = Native groundcover – other |
| NOS = Native overstorey cover | EPC = Exotic percent cover |
| NMS = Native midstorey cover | NTH = Number of trees with hollows |
| NGCG = Native groundcover – grass | OR = Overstorey regeneration |
| NGCS = Native groundcover - shrubs | FL = Fallen logs (m) |

The site value scores for each vegetation zone are provided in Table 6-10.

Table 6-10 Area and site value score for each vegetation zone

| Vegetation Zone | Area mapped in Amended Proposal Site | Site value score |
|---|--------------------------------------|------------------|
| MPW Stage 2 Site | | |
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good | 9.81 ha | 56.25 |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin: Moderate/Good | 0.46 ha | 33.33 |
| Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good | 23.94 ha | 56.25 |
| Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor | 3.94 ha | 29.69 |
| Moorebank Avenue Site | | |
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good | 3.73 ha | 55.73 |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin: Moderate/Good | 0.22 ha | 33.33 |
| Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good | 0.59 ha | 34.38 |

6.6 Noxious weeds

Review of the flora species list for the MPW Site against the current list of priority weeds for Liverpool City Council (DPI 2017) identified 12 priority weeds listed under the *Biosecurity Act 12015*, of which nine are also listed as Weeds of National Significance (Australian Weeds Committee 2010). The noxious weeds recorded on and adjacent to the Amended Proposal site are listed in Table 6-11.

Table 6-11 Noxious weeds recorded in the Amended Proposal Site and adjoining areas

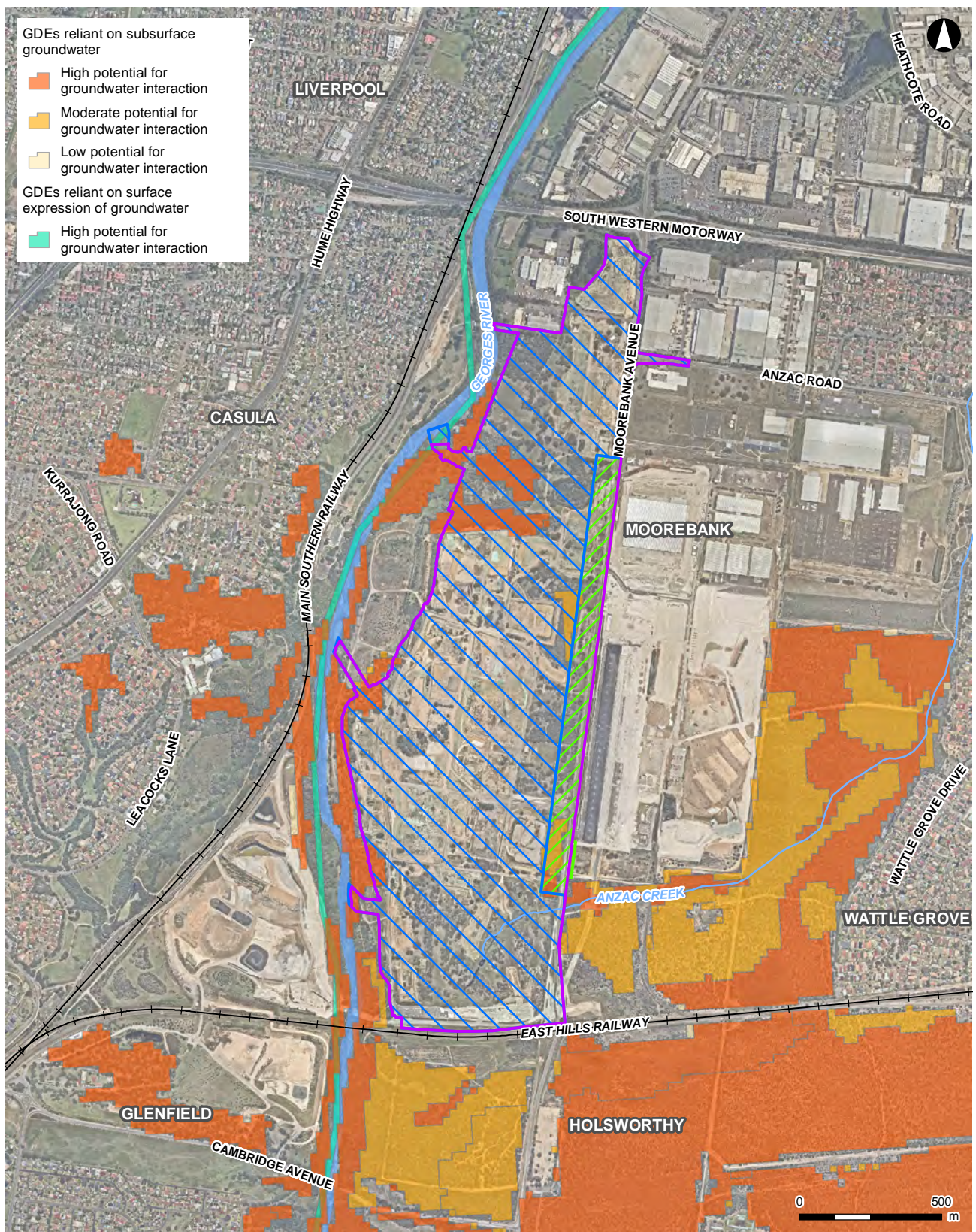
| Scientific name | Common name | Control Class | Weed of National Significance |
|---|-------------------|---------------|-------------------------------|
| <i>Alternanthera philoxeroides</i> | Alligator Weed | 3 | Yes |
| <i>Arundo donax</i> | Giant Reed | 4 | No |
| <i>Asparagus aethiopicus</i> | Ground Asparagus | 4 | Yes |
| <i>Asparagus asparagoides</i> | Bridal Creeper | 4 | Yes |
| <i>Chrysanthemoides monilifera</i> subsp. <i>monilifera</i> | Boneseed | 1 | Yes |
| <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> | Bitou Bush | 3 | Yes |
| <i>Lantana camara</i> | Lantana | 4 | Yes |
| <i>Ludwigia peruviana</i> | Peruvian Primrose | 3 | No |
| <i>Olea europaea</i> subsp. <i>cuspidata</i> | African Olive | 4 | No |
| <i>Rubus fruticosus</i> | Blackberry | 4 | Yes |
| <i>Sagittaria platyphylla</i> | Sagittaria | 4 | Yes |
| <i>Salvinia molesta</i> | Salvinia | 2 | Yes |
| <i>Senecio madagascariensis</i> | Fireweed | 4 | Yes |

6.7 Groundwater Dependent Ecosystems

Geotechnical and Phase 2 investigations of the Amended Proposal Site have found groundwater at depths of between 5.2 and 12.4 m Below Ground Level (BGL) (1.7 and 9.11 m Australian Height Datum (AHD)). Local groundwater flow is inferred to be west to the north-west towards the Georges River (Parsons Brinckerhoff 2014b).

It is probable, due to local hydrogeology, that groundwater across the Amended Proposal Site and the wider region is interconnected. As such, if stygofauna (aquatic animals that live in groundwater) were present they are unlikely to be isolated to the vicinity of the Amended Proposal Site.

A search of the Australian Government's Atlas of Groundwater Dependent Ecosystems was undertaken on 7 April 2016. Several GDEs with potential reliance on subsurface groundwater were identified in the locality including in the Amended Proposal Site (Bureau of Meteorology 2016). Results are mapped in Figure 6-4. Riparian woodland vegetation adjoining the Georges River was identified as having a high potential for groundwater interaction. Some of the fragmented patches of vegetation along the eastern boundary of the Amended Proposal Site were identified as having a moderate potential for groundwater interaction. No data on subterranean groundwater-dependent ecosystems (GDEs) is available for the locality.



7 THREATENED SPECIES

7.1 Ecosystem credit species

The FBA Assessment for the MPW Concept Approval found 21 ecosystem credit species predicted to occur within the MPW Concept Approval Development Site. Although none of the species were recorded in the MPW Concept Approval Development Site, 13 were considered to have a moderate to high likelihood of occurrence there. The species are listed in Table 3.16 of PB (2015b).

A total of 24 species were derived from the PCTs identified on the Amended Proposal Site as predicted ecosystem credit species for the Amended Proposal. This total includes all species identified in the FBA calculation prepared for the MPW Concept Approval, plus three additional species: Spotted Harrier (*Circus assimilis*), Square-tailed Kite (*Lophoictinia isura*) and Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*):

- Barking Owl (*Ninox connivens*)
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis* subsp. *gularis*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus* subsp. *victoriae*)
- Bush-stone Curlew (*Burhinus grallarius*)
- Diamond Firetail (*Stagonopleura guttata*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Flame Robin (*Petroica phoenicea*)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Hooded Robin (south-eastern form) (*Melanodryas cucullata* subsp. *cucullata*)
- Little Eagle (*Hieraaetus morphnoides*)
- Little Lorikeet (*Glossopsitta pusilla*)
- New Holland Mouse (*Pseudomys novaehollandiae*)
- Painted Honeyeater (*Grantiella picta*)
- Powerful Owl (*Ninox strenua*)
- Scarlet Robin (*Phoenica boodang*)
- Speckled Warbler (*Chthonicola sagittata*)
- Spotted Harrier (*Circus assimilis*)
- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)
- Square-tailed Kite (*Lophoictinia isura*)
- Swift Parrot (*Lathamus discolor*)
- Varied Sitella (*Daphoenositta chrysoptera*)
- Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)

Each species has been assessed for potential presence in the Amended Proposal Site in Table 7-1 using information obtained from the Threatened Species Profiles Database (TSPD).

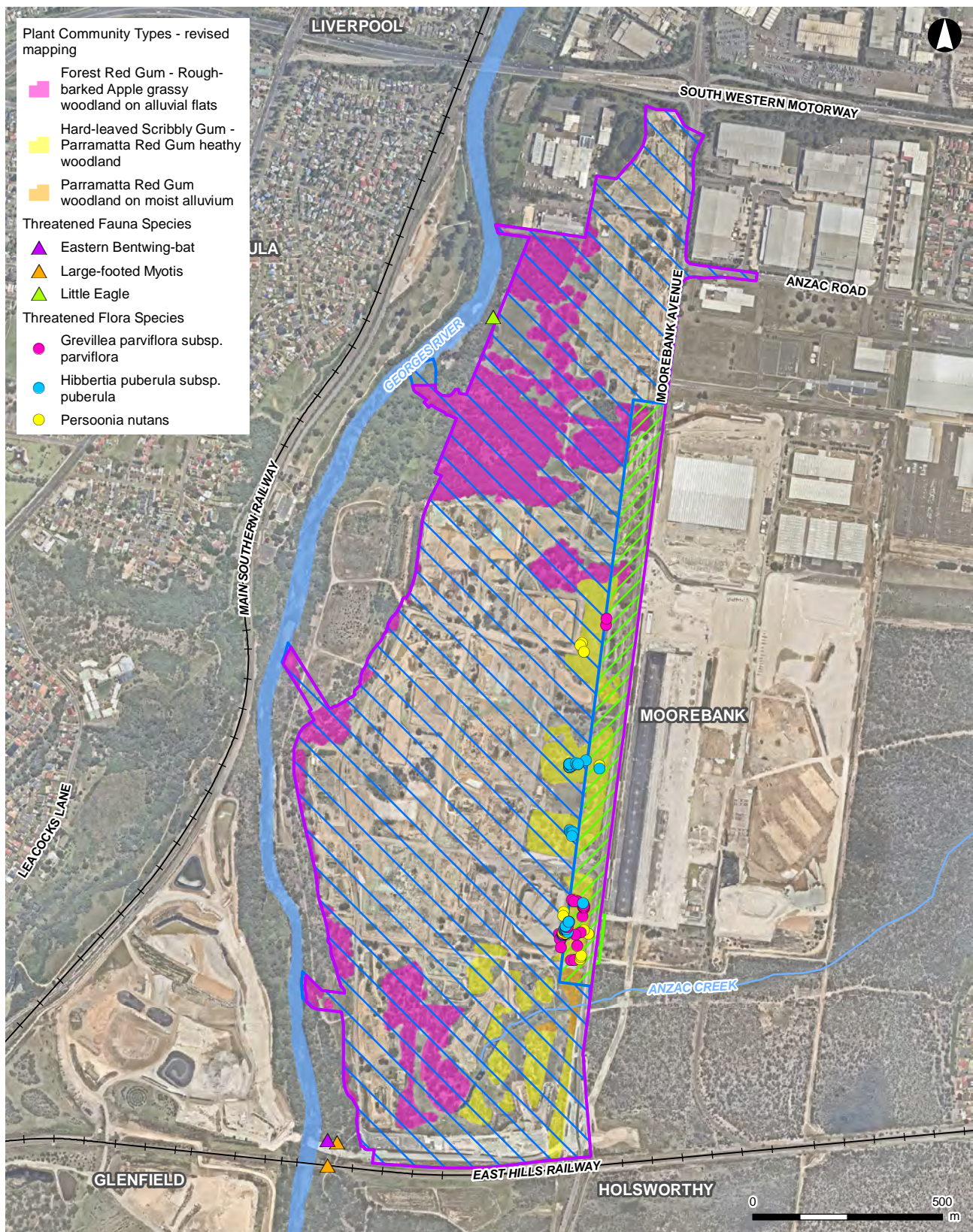
The assessment found that of the 24 species identified in the calculator, two have a high likelihood of occurrence and 13 have a moderate likelihood of occurrence in the Amended Proposal Site. One species, Little Eagle, was recorded in the Georges River riparian corridor, about 200 metres north of proposed basin outlet 5 (PB 2015c) (Figure 7-1).

Bat calls attributable to either the Greater Broad-nosed Bat (*Scoteanax rueppellii*) or Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), both listed as Vulnerable under the TSC Act, were also recorded by PB (2014a). These calls were not of sufficient quality to reliably differentiate the species; however they were considered more likely to be the Greater Broad-nosed Bat, based on presence of suitable habitat and previous records in the locality (PB 2014a). Both species are identified as predicted ecosystem credit species in the calculator.

The threatened species with the highest Threatened Species (TS) offset multiplier in each vegetation zone determine the final ecosystem credit value. The two threatened owl species which have a moderate likelihood of occurrence on the Amended Proposal Site, Barking Owl and Powerful Owl, have a high offset multiplier score of 3.0; this score is only relevant to breeding habitat containing large tree hollows, which does not occur in the Amended Proposal Site. Although PB (2015b) considered that breeding habitat for Barking Owl and Powerful Owl occurred in the Georges River riparian zone, no trees with large hollows were observed within the areas of the proposed sediment basin outlets. As such, the offset multiplier has been lowered to 1.5 for these species, in accordance with the guidance in OEH (2016) and as allowed for under Section 2.2.2 of the FBA. Ecosystem credit species considered unlikely to occur, based on review of habitat requirements, were removed from the calculator. The species with the highest offset multiplier, following adjustment or removal of species, was Greater Broad-nosed Bat, with an offset multiplier of 2.2.

Three additional ecosystem credit species not identified by the credit calculator were either recorded or tentatively identified in the Amended Proposal Site:

- Grey-headed Flying-fox (*Pteropus poliocephalus*), listed as Vulnerable under the TSC Act and EPBC Act, was recorded flying over the Amended Proposal Site by PB (2014a).
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), listed as Vulnerable under the TSC Act, was recorded by Hyder Consulting (2015) in the Georges River riparian corridor to the south-west of the Amended Proposal Site (Figure 7-1). The species was recorded in an earlier fauna study of the site in 2003 (LesryK Environmental Consultants 2003, cited in PB 2014a) and possible recordings of the species were also made by PB (2014a).
- Possible recordings of Large-footed Myotis (*Myotis macropus*) were made by Hyder Consulting (2015) in the Georges River riparian corridor to the south-west of the Amended Proposal Site (Figure 7-1), and by PB (2014a). This species was also recorded in the LesryK (2005) fauna study of the site.



LEGEND

- Amended Proposal site
- MPW Stage 2 site
- Moorebank Avenue site
- Existing railway
- Watercourse

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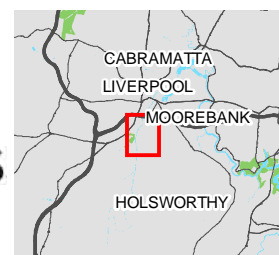


Figure 6-5 Impacts to threatened flora and ecological communities associated with the MPW project

Table 7-1 Predicted ecosystem credit species presence assessment

| Predicted ecosystem credit species | Patch size | TS Offset multiplier | Habitat requirements (from TSPD) | Ecosystem credit species habitat presence on Amended Proposal Site? | Species likelihood of occurrence on Amended Proposal Site (based on PB assessment of MPW Site 2014/2015) |
|--|------------|--------------------------------|---|---|--|
| Barking Owl <i>Ninox connivens</i> V-TSC Act Not listed – EPBC Act | 25-100 ha | (3.0) revised to 1.5 | Foraging habitat includes associated vegetation types and up to 250 m from these into adjoining grassland. Larger trees and hollow trees facilitate a more diverse and abundant prey base, thus improving breeding success. Living or dead trees with hollows >20 cm diameter that are > 4 m above the ground are required for breeding. | Yes | Moderate |
| Black-chinned Honeyeater (eastern subspecies) <i>Melithreptus gularis</i> subsp. <i>gularis</i> V-TSC Act Not listed – EPBC Act | 5-25 ha | 1.3 | Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares. | Yes | Moderate |
| Brown Treecreeper (eastern subspecies) <i>Climacteris picumnus</i> subsp. <i>victoriae</i> V-TSC Act Not listed – EPBC Act | 5-25 ha | 2.0 | Associated vegetation types provide foraging and refuge habitat for the species. Hollows >6cm in live trees or in dead standing or fallen timber provide breeding habitat. | Yes | Unlikely |

| Predicted ecosystem credit species | Patch size | TS Offset multiplier | Habitat requirements (from TSPD) | Ecosystem credit species habitat presence on Amended Proposal Site? | Species likelihood of occurrence on Amended Proposal Site (based on PB assessment of MPW Site 2014/2015) |
|--|------------|----------------------|--|---|--|
| Bush Stone-curlew <i>Burhinus grallarius</i> E-TSC Act Not listed – EPBC Act | 25-100 ha | 2.6 | Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Associated vegetation types provide foraging and refuge habitat for the species. Open grassy woodland with fallen dead timber provides breeding habitat. | Yes | Unlikely |
| Diamond Firetail <i>Stagonopleura guttata</i> V-TSC Act Not listed – EPBC Act | <5 ha | 1.3 | Foraging habitat includes associated vegetation types with native grassy understorey or adjoining native grassland. Does not occur within grasslands which are further than 1.5 km from trees or woodland. Breeding occurs in vegetation with small patches of shrubs. | Yes | Unlikely |
| Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i> V-TSC Act Not listed – EPBC Act | 5-25 ha | 2.2 | Prefers moist habitats, with trees taller than 20 m. Associated vegetation types provide foraging habitat for the species. Species roosts in live or dead hollow-bearing trees, under bark, caves buildings. | Yes | Moderate |
| Eastern Freetail-bat <i>Mormopterus norfolkensis</i> V-TSC Act Not listed – EPBC Act | 5-25 ha | 2.2 | Associated vegetation types provide foraging habitat for the species. Species roosts in tree hollows, loose bark or man-made structures. Breed in hollows in dead or alive trees. | Yes | High |
| Flame Robin <i>Petroica phoenicea</i> | 25-100 ha | 1.3 | Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the | Yes | Moderate |

| Predicted ecosystem credit species | Patch size | TS Offset multiplier | Habitat requirements (from TSPD) | Ecosystem credit species habitat presence on Amended Proposal Site? | Species likelihood of occurrence on Amended Proposal Site (based on PB assessment of MPW Site 2014/2015) |
|---|------------|----------------------|---|---|--|
| V-TSC Act Not listed – EPBC Act | | | breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. | | |
| Gang-gang Cockatoo <i>Callocephalon fimbriatum</i> V-TSC Act Not listed – EPBC Act | <5 ha | 2.0 | In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. Favours old growth attributes required for nesting and roosting purposes. Uses hollows for breeding >10cm diameter and >9m above the ground. | Yes | Moderate |
| Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> V-TSC Act Not listed – EPBC Act | <5 ha | 2.2 | Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. | Yes | Moderate |
| Hooded Robin (south-eastern form) <i>Melanodryas cucullata</i> subsp. <i>cucullata</i> V-TSC Act Not listed – EPBC Act | 5-25 ha | 1.7 | Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. | Yes | Unlikely |

| Predicted ecosystem credit species | Patch size | TS Offset multiplier | Habitat requirements (from TSPD) | Ecosystem credit species habitat presence on Amended Proposal Site? | Species likelihood of occurrence on Amended Proposal Site (based on PB assessment of MPW Site 2014/2015) |
|---|------------|--------------------------------|---|---|--|
| Little Eagle <i>Hieraaetus morphnoides</i> V-TSC Act Not listed – EPBC Act | <5 ha | 1.4 | Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. | Yes | Recorded in Georges River riparian corridor |
| Little Lorikeet <i>Glossopsitta pusilla</i> V-TSC Act Not listed – EPBC Act | <5 ha | 1.8 | Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. | Yes | High |
| New Holland Mouse <i>Pseudomys novaehollandiae</i> Not listed – TSC Act V-EPBC Act | <5 ha | 2.6 | Known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. | Marginal | Unlikely |
| Painted Honeyeater <i>Grantiella picta</i> V-TSC Act Not listed – EPBC Act | <5 ha | 1.3 | Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. | Yes | Unlikely |
| Powerful Owl <i>Ninox strenua</i> | >100 ha | (3.0) revised to 1.5 | Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland | Yes | Moderate |

| Predicted ecosystem credit species | Patch size | TS Offset multiplier | Habitat requirements (from TSPD) | Ecosystem credit species habitat presence on Amended Proposal Site? | Species likelihood of occurrence on Amended Proposal Site (based on PB assessment of MPW Site 2014/2015) |
|--|------------|----------------------|--|---|--|
| V-TSC Act Not listed – EPBC Act | | | habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation. Nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. | | |
| Scarlet Robin <i>Petroica boodang</i> V-TSC Act Not listed – EPBC Act | 25-100 ha | 1.3 | The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Abundant logs and fallen timber are important habitat components. | Yes | Moderate |
| Speckled Warbler <i>Chthonicola sagittata</i> V-TSC Act Not listed – EPBC Act | 5-25 ha | 2.6 | The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. | Yes | Unlikely |
| Spotted Harrier <i>Circus assimilis</i> V-TSC Act Not listed – EPBC Act | <5 ha | 1.4 | Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. | Yes | Moderate |

| Predicted ecosystem credit species | Patch size | TS Offset multiplier | Habitat requirements (from TSPD) | Ecosystem credit species habitat presence on Amended Proposal Site? | Species likelihood of occurrence on Amended Proposal Site (based on PB assessment of MPW Site 2014/2015) |
|---|------------|----------------------|---|---|--|
| Spotted-tailed Quoll <i>Dasyurus maculatus</i> V-TSC Act E-EPBC Act | 25-100 ha | 2.6 | Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. | Yes | Unlikely |
| Square-tailed Kite <i>Lophoictinia isura</i> V- TSC Act Not listed – EPBC Act | 25-100 ha | 1.4 | Found in a variety of timbered habitats including dry woodlands and open forests, showing a particular preference for timbered watercourses. Appears to occupy large hunting ranges of more than 100km ² . | Yes | Moderate |
| Swift Parrot <i>Lathamus discolor</i> E-TSC Act E-EPBC Act | <5 ha | 1.3 | Occurs in areas where eucalypts are flowering profusely or where there are abundant lerp (honeydew produced by sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> . | Yes | Moderate |
| Varied Sittella <i>Daphoenositta chrysoptera</i> V-TSC Act Not listed – EPBC Act | 5-25 ha | 1.3 | Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. | Yes | Moderate |
| Yellow-bellied Sheath-tail-bat | <5 ha | 2.2 | Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise | Yes | Moderate |

| Predicted ecosystem credit species | Patch size | TS Offset multiplier | Habitat requirements (from TSPD) | Ecosystem credit species habitat presence on Amended Proposal Site? | Species likelihood of occurrence on Amended Proposal Site (based on PB assessment of MPW Site 2014/2015) |
|---|------------|----------------------|---|---|--|
| <i>Saccolaimus flaviventris</i> V-TSC Act Not listed – EPBC Act | | | mammal burrows. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. | | |

7.2 Species credit species

7.2.1 Flora

The FBA Assessment for the MPW Concept Approval found 13 flora species credit species predicted to occur within the MPW Concept Approval Development Site. The species are listed in Table 3.14 of PB (2015b).

A total of 13 species were also identified in the credit calculator as predicted flora species credit species for the Amended Proposal Site. This total includes all species identified in the FBA calculation prepared for the MPW Concept Approval, with the exception of *Pultenaea parviflora*. One additional species, *Persoonia hirsuta* (Hairy Geebung), was derived as a predicted species in the calculation for this BAR.

- *Acacia bynoeana* (Bynoe's Wattle)
- *Caladenia tessellata* (Thick-Lip Spider Orchid)
- *Callistemon linearifolius* (Netted Bottle Brush)
- *Cynanchum elegans* (White-Flowered Wax Plant)
- *Dillwynia tenuifolia*
- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)
- *Hibbertia puberula*
- *Hibbertia* sp. *Bankstown*
- *Hypsela sessiliflora*
- *Leucopogon exolasius* (Woronora Beard-heath)
- *Persoonia hirsuta* (Hairy Geebung)
- *Persoonia nutans* (Nodding Geebung)
- *Pimelea curviflora* subsp. *curviflora*.

Table 7-2 assesses the potential for these flora species credit species to be present on the Amended Proposal Site using information from the TSPD. It also identifies species that cannot withstand further loss and whether further action is required.

Wahlenbergia multicaulis (Tadgells Bluebell) in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield, listed as an Endangered Population under the TSC Act, was also predicted to occur within the Amended Proposal Site by the credit calculator. As this population is not endangered in the Liverpool LGA, it was not considered further in the current assessment.

Two of the threatened flora species credit species identified in the credit calculator were recorded on the MPW Site by PB (2014a): *Persoonia nutans* (Nodding Geebung) and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea).

PB (2014a) recorded at least 16 apparent individuals (individual shrubs or groups of suckers) of *Grevillea parviflora* subsp. *parviflora*. The precise number of individuals of this species present was considered difficult to gauge due to its suckering habit and the possible presence of a soil seedbank. Approximately 10 individuals of *Persoonia nutans* were recorded.; it was considered that additional individuals may also be represented in a soil seed bank.

Both species were recorded in the Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin in the east of the Amended Proposal Site.

The areas of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland were subject to additional targeted surveys in February and March 2017 by Arcadis.

The Arcadis 2017 survey recorded 333 stems of *Grevillea parviflora* and 16 *Persoonia nutans* in approximately the same locations as presented in PB (2014 and 2015b). It should be noted that *Grevillea parviflora* subsp. *parviflora* was previously assessed based on number of individuals, whereas the Arcadis 2017 surveys counted the number of stems, in accordance with information in the threatened species profiles for the species (OEH 2017) and for consistency with targeted surveys within the offset site. In one location, there were 200 stems counted within an approximately 10 metre x 2 metre area – it is possible that these stems represent one genetic individual.

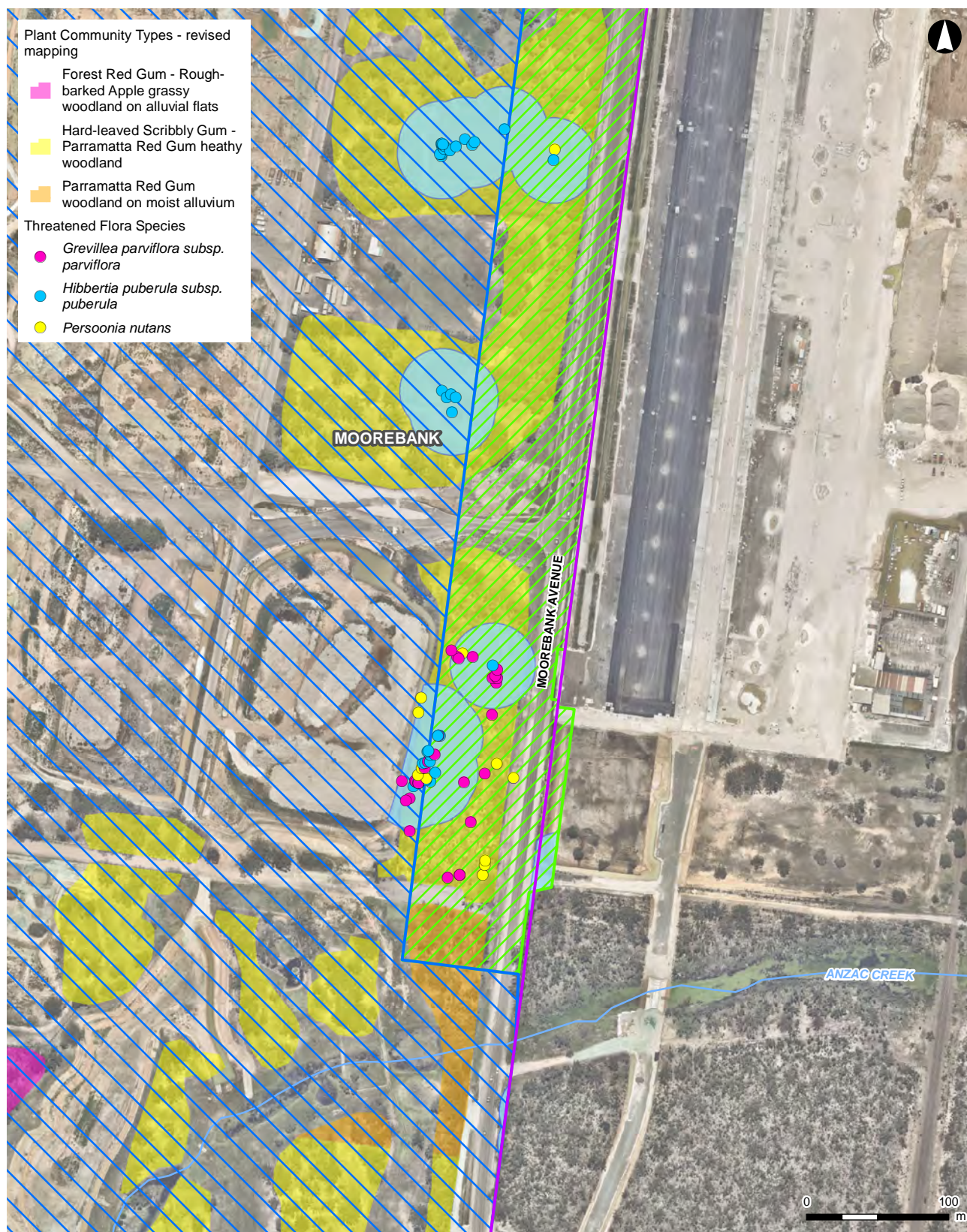
The *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* recorded on the Amended Proposal Site are discussed in detail in PB (2014a).

One additional threatened flora species not previously recorded on the Amended Proposal Site was identified in the Arcadis 2017 survey: *Hibbertia puberula* subsp. *puberula*. This species was recorded in two of the larger patches of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland in the central eastern parts of the Amended Proposal Site. Most of the recorded individuals of this species retained flowering and fruiting material, and as such a positive identification could be confirmed in the field. A total of 83 plants were recorded. These 83 plants represent an area of occupancy of 2.0 hectares (see Section 4.2.4). Figure 7-2 shows how the species polygon for *Hibbertia puberula* subsp. *puberula* has been created based on the 38 recorded plants within the Amended Proposal Site.

Hibbertia puberula subsp. *puberula* is a subspecies of *Hibbertia puberula*, listed as endangered under the NSW *Threatened Species Conservation Act 1995* on 12 September 2003. At the time of listing, *Hibbertia puberula* had not been collected for over 40 years. There are no records of *Hibbertia puberula* subsp. *puberula* in the NSW Wildlife Atlas (<http://www.bionet.nsw.gov.au/>) between 1954 and 2012, when it was recorded near Heathcote Road at Lucas Heights and Menai.

Toelken and Miller (2012) reported that *Hibbertia puberula* subsp. *puberula* was more widespread than previously thought, based on over 50 specimens collected from varying locations including Wollemi National Park, Voyager Point, Simmos Beach Reserve at Macquarie Fields, Kentlyn, Warrimoo, Royal National Park and areas south-west of Nowra, near Morton National Park. The species has been recorded from a wide range of habitats and Toelken and Miller (2012) state that it seems to be adequately conserved.

The locations of the threatened flora species recorded in the Amended Proposal Site are shown on Figure 7-2.



LEGEND

- Amended Proposal site
- MPW Stage 2 site
- Moorebank Avenue site
- Hibbertia puberula* subsp. *puberula* species polygon
- Watercourse

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 Coordinate System: GDA 1994 MGA Zone 56
 Aerial imagery supplied by nearmap (Dec, 2018)

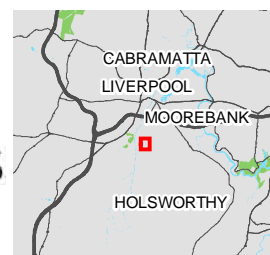
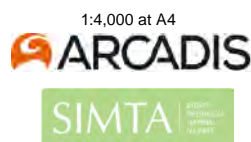


Figure 7-2: *Hibbertia puberula* subsp. *puberula* species polygon

Table 7-2 Flora species credit species and their presence status

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|---|---|--|--|---|--|--|-----------------|
| <i>Acacia bynoeana</i> Bynoe's Wattle E-TSC Act V-EPBC Act | Heath or dry sclerophyll forest on sandy soils. Prefers open, sometimes slightly disturbed sites. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple. | Potential habitat present | Targeted searches within potential habitat areas | November 2010, February 2013, May 2014, September 2014, February-March 2017 | Unlikely. The species was not found during multiple targeted surveys. | No | Not required |
| <i>Caladenia tessellata</i> Thick Lip Spider Orchid E – TSC Act V – EPBC Act | Generally found in grassy sclerophyll woodland on clay loam or sandy soils. | Marginal habitat present | Targeted searches within potential habitat areas | November 2010, February 2013, May 2014, September 2014, February-March 2017 | Unlikely. The species was not found during multiple targeted surveys. | No | Not required |
| <i>Callistemon linearifolius</i> Netted Bottlebrush V – TSC Act | The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically | No. | No typical habitat in study area. | Species not targeted. | Unlikely to occur; no nearby records and typical habitat is not present. | No | Not required |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|---|---|--|---|------------------------|--|--|-----------------|
| Not listed – EPBC Act | <p>recorded in the Sydney area. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River.</p> <p>Grows in dry sclerophyll forest on the coast and adjacent ranges. Open-forest e.g. with <i>Corymbia eximia</i>, <i>Eucalyptus punctata</i>, <i>E. umbra</i>, <i>Allocasuarina littoralis</i>, <i>Angophora costata</i>; sandy to clayey soils on sandstone.</p> | | | | | | |
| <i>Cynanchum elegans</i> White-flowered Wax Plant E-TSC Act V-EPBC Act | <p>Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; <i>Leptospermum laevigatum</i> – <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; <i>Eucalyptus tereticornis</i> aligned open forest and</p> | No suitable habitat exists within the Amended Proposal Site. | N/A – species not targeted as unlikely to occur | N/A | Unlikely. No suitable habitat present. | No | Not required |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|---|---|--|--|---|--|---|--------------------|
| | woodland; <i>Corymbia maculata</i> aligned open forest and woodland; and <i>Melaleuca armillaris</i> scrub to open scrub. | | | | | | |
| <i>Dillwynia tenuifolia</i> V-TSC Act Not listed – EPBC Act | May be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. | Potential habitat present | Targeted searches within potential habitat areas | November 2010, February 2013, May 2014, September 2014, February-March 2017 | Unlikely. The species was not found during targeted surveys. | No | Not required |
| <i>Grevillea parviflora</i> subsp. <i>parviflora</i> Small-flower Grevillea V-TSC Act V-EPBC Act | Grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the | Occupied habitat present | Targeted searches within potential habitat areas | November 2010, February 2013, May 2014, September 2014, February-March 2017 | Recorded during targeted surveys | No | Yes |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|---|---|--|---|---|---|--|-----------------|
| | Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park. | | | | | | |
| <i>Hibbertia puberula</i> subsp. <i>puberula</i> E – TSC Act Not listed – EPBC Act | Occurs on sandy soil often associated with sandstone, or on clay. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. One of the recently (2012) described subspecies also favours upland swamps. | Occupied habitat present | Targeted searches within potential habitat areas. | November 2010, February 2013, May 2014, September 2014, February-March 2017 | <i>Hibbertia puberula</i> subsp. <i>puberula</i> recorded during targeted surveys | Yes | Yes |
| <i>Hibbertia</i> sp. <i>Bankstown</i> (syn. <i>Hibbertia puberula</i> subsp. <i>glabrescens</i>) CE-TSC Act CE-EPBC Act | The species is currently known to occur in only one population at Bankstown Airport. The airport site is very heavily modified from the natural state, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced | Habitat in the Amended Proposal Site was considered unlikely to be suitable. | N/A – species not targeted as unlikely to occur. | November 2010, February 2013, May 2014, September 2014, February-March 2017 | Unlikely. | No | Not required |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|--|--|--|--|---|--|--|-----------------|
| | herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content. | | | | | | |
| <i>Hypsela sessiliflora</i> (syn. <i>Isotoma sessiliflora</i>) Not listed – TSC Act Ex-EPBC Act (Note: this species was removed from the TSC Act on 25 November 2016). | Currently known from only two adjacent sites on a single private property at Erskine Park in the Penrith LGA. Previous sightings are all from western Sydney, at Homebush and at Agnes Banks. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. | No. | N/A – species not targeted as unlikely to occur. | N/A | Unlikely. No suitable habitat present. | No | Not required |
| <i>Leucopogon exolasius</i> Woronora Beard-heath | Occurs in woodland on sandstone. | Marginal habitat may be present. | Targeted searches within potential habitat areas | November 2010, February 2013, May 2014, | Unlikely. The species was not found during | No | Not required |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|---|--|---|--|---|--|--|-----------------|
| V-TSC Act V-EPBC Act | | | | September 2014, February-March 2017 | targeted surveys. | | |
| <i>Persoonia hirsuta</i> Hairy Geebung E-TSC Act E-EPBC Act | Found found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone | Marginal habitat may be present. | Targeted searches within potential habitat areas | November 2010, February 2013, May 2014, September 2014, February-March 2017 | Unlikely. The species was not found during targeted surveys. | No | Not required |
| <i>Persoonia nutans</i> Nodding Geebung E-TSC Act E-EPBC Act | This species occupies tertiary alluvium, extending onto shale sandstone transition communities and into Cooks River / Castlereagh Ironbark Forest. | Occupied habitat present. | Targeted searches within potential habitat areas | November 2010, February 2013, May 2014, September 2014, February-March 2017 | Recorded during targeted surveys | No | Yes |
| <i>Pimelea curviflora</i> subsp. <i>curviflora</i> V-TSC Act | Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the | No. The Amended Proposal Site is outside of | N/A – species not targeted as unlikely to occur. | N/A | Unlikely. No suitable habitat present. | No | Not required |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|----------------------------------|--|--|---------------------------------|------------------------|-----------------|--|-----------------|
| V-EPBC Act | north-west. Distribution associated with shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. | the known distribution of the species in the Sydney region. Typical habitat does not occur in the Amended Proposal Site. | | | | | |

7.2.2 Fauna

The FBA Assessment for the MPW Concept Approval identified eight fauna species credit species predicted to occur within the MPW Concept Approval Development Site. Although none of the species were recorded in the MPW Concept Approval Development Site, one (Regent Honeyeater) was considered to have a moderate likelihood of occurrence there. The species are listed in Table 3.16 of PB (2015b).

A total of eight species were identified in the credit calculator as predicted species credit species for the Amended Proposal Site. This total includes all species identified in the MPW Concept Approval FBA calculation, with the exception of Rosenberg's Goanna (*Varanus rosenbergi*). One additional species, Black Bittern (*Ixobrychus flavicollis*), was derived as a predicted species in the calculation for this BAR.

- Black Bittern (*Ixobrychus flavicollis*)
- Cumberland Plain Land Snail (*Meridolum corneovirens*)
- Eastern Osprey (*Pandion cristatus*)
- Eastern Pygmy-possum (*Cercartatus nanus*)
- Green and Golden Bell Frog (*Litoria aurea*)
- Koala (*Phascolarctos cinereus*)
- Regent Honeyeater (*Anthochaera phrygia*)
- Squirrel Glider (*Petaurus norfolkensis*)

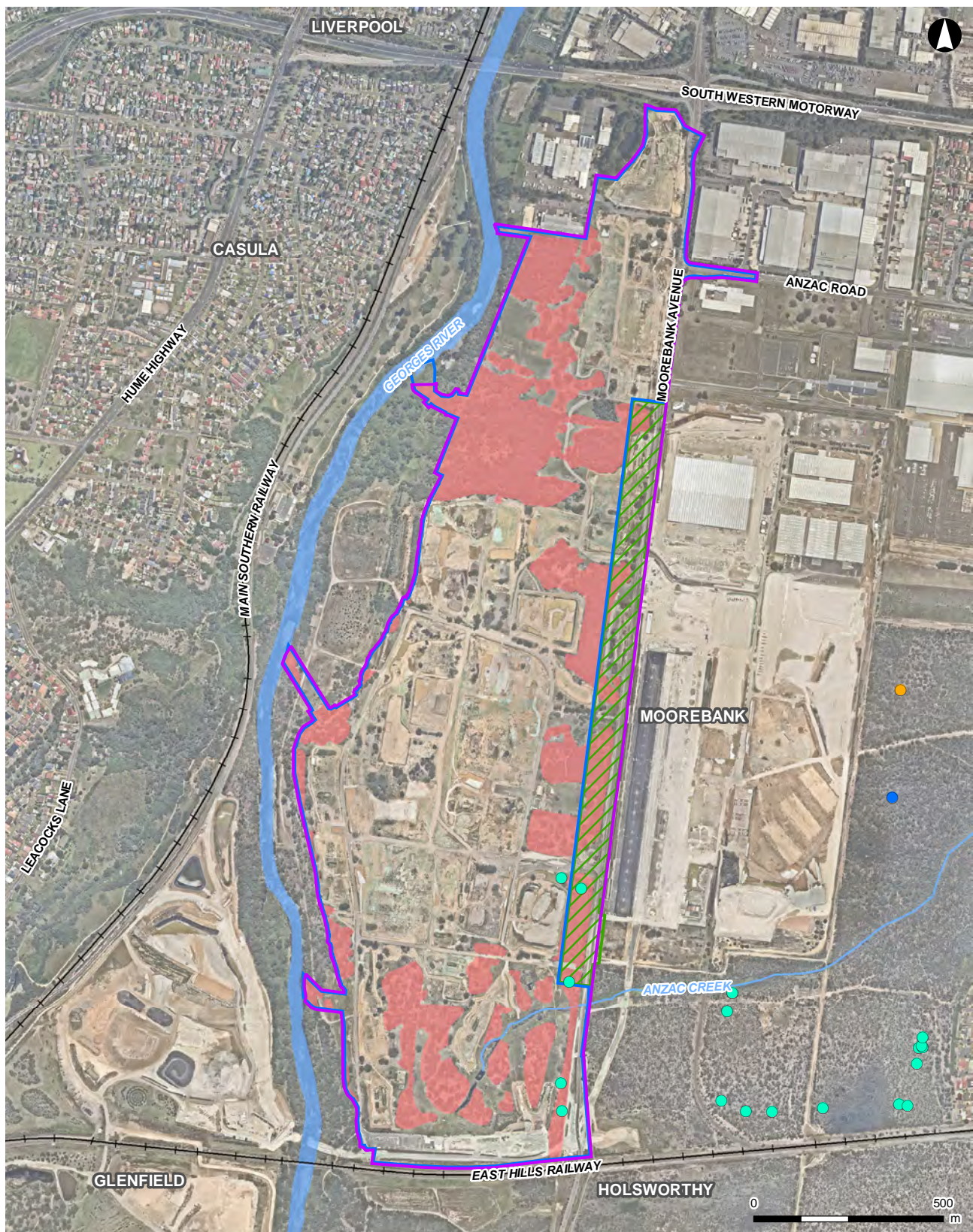
Table 7-3 assesses the potential for fauna species credit species to be present within the Amended Proposal Site using information obtained from the TSPD. Habitat requirements for each species were assessed against the habitat values on the Amended Proposal Site. Habitat information was obtained from OEH's Threatened Species Profiles Database. Targeted survey methods and timing for each identified species is noted and an assessment of the presence status of each species was determined based on targeted survey results and habitat presence. Table 7-3 also identifies species that cannot withstand further loss and whether any further assessment is required.

Koala scats were recorded using a detection dog during targeted surveys at five locations in the south eastern portion of the Amended Proposal Site. Koala scats were also recorded at 14 locations within the Bootland from detection dog and Rapid SAT surveys (Cumberland Ecology 2018). One individual Koala was recorded in the Bootland from IR camera surveys (Cumberland Ecology 2019). No individual Koalas have been recorded within the Amended Proposal Site during any surveys. The locations of Koala scat and IR camera records are shown in Figure 7-3.

Given the connectivity to known populations of Koalas to the south (Phillips 2016a) it is feasible that the Bootland of the Moorebank Precinct may be within the northern limits of extant Koala territories, and the species may have always used this vegetation despite the absence of records. Koalas have not been recorded during previous surveys of the Moorebank Precinct, and the current survey data indicates a low density of Koalas. The recent records of one or more Koalas within the Amended Proposal Site is therefore considered likely to comprise one or more transient or dispersing animals rather than a resident breeding population (Cumberland Ecology 2018).

No Cumberland Plain Land Snails were recorded from the Amended Proposal Site during previous surveys. Further targeted surveys were undertaken by Cumberland Ecology (2018) in response to the unexpected find of a Cumberland Plain Land Snail shell from the northern Bootland adjacent to the Moorebank Precinct East Project (Arcadis 2018). Cumberland Plain Land Snail was not recorded within the Amended Proposal Site during recent targeted surveys (Cumberland Ecology 2018). Habitat assessment undertaken during the targeted survey determined that the Amended Proposal Site supports only marginal habitat for the Cumberland Plain Land Snail. Further, the Cumberland Plain Land Snail is a relatively immobile species which is unlikely to cross barriers between the Bootlands and the Amended Proposal Site such as the Moorebank Precinct East development site, the East Hills Rail corridor or Moorebank Avenue.

Based on the results of the assessment, including the combined results of previous and recent targeted surveys and habitat assessments, it is considered that the Cumberland Plain Land Snail is unlikely to occur in the Amended Proposal Site. Of the eight predicted species, only one (Koala) was recorded during surveys. No other predicted species are considered likely to occur in the Amended Proposal Site based on the assessment provided in Table 7-3.



LEGEND

- Amended Proposal site
- MPW Stage 2 site
- Moorebank Avenue site
- Koala detection dog - scats
- Rapid-SAT - scats
- IR camera - Koala recorded
- Koala species polygon
- Existing railway
- Watercourse

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 Coordinate System: GDA 1994 MGA Zone 56
 Aerial imagery supplied by nearmap (Dec, 2018)



Figure 7-3 Supplementary Koala survey results

Table 7-3 Fauna species credit species and their presence status

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|---|---|--|---|--|--|--|-----------------|
| Black Bittern <i>Ixobrychus flavicollis</i> V-TSC Act | Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. | No. Wetlands on the Amended Proposal Site are heavily degraded and have minimal or no fringing vegetation, which this species prefers. | Diurnal bird surveys: 8 person hours (2 sessions in each of 4 locations). | November 2010 | Unlikely. The species was not found during targeted surveys. | Yes | Not required |
| Cumberland Plain Land Snail <i>Meridolum corneovirens</i> E-TSC Act | Occurs in bark or leaf litter accumulation in associated vegetation types (ME003, ME005, ME018). Primarily inhabits Cumberland Plain Woodland; also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest. It lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. | Yes. Amended Proposal Site supports small isolated areas of marginal habitat. | 6 person hours of hand searches in areas of potential habitat. 1 day of habitat assessment and habitat searches by one person (Cumberland Ecology) | November 2010 and December 2018 (Cumberland Ecology) | Unlikely. The species was not found during targeted surveys. | Yes | Not required |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|---|--|--|--|------------------------|---|--|-----------------|
| | Occasionally shelters under rubbish. | | | | | | |
| Eastern Osprey <i>Pandion cristatus</i> V-TSC Act | Favours coastal areas especially the mouths of large rivers, lagoons and lakes. Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea. | No. Eastern Osprey favours coastal areas and is rare to uncommon in closely settled areas. Unlikely to breed on site as species typically nests within 1km of the ocean. | Diurnal bird surveys: 8 person hours (2 sessions in each of 4 locations) | November 2010 | Unlikely. The species is only found away from the coast as a vagrant. | Yes | Not required |
| Eastern Pygmy-possum <i>Cercartetus nanus</i> V-TSC Act | Inhabits woodlands and heath, occasionally rainforest where it forages for nectar and pollen of banksias, eucalypts and bottlebrushes. Shelters in tree hollows, rotten stumps, holes in the ground or abandoned bird-nests. | No. Vegetation on the Amended Proposal Site is heavily degraded, leaving it unsuitable for the species. There are a few patches of very marginal habitat on the Amended Proposal Site which are unlikely to be | Spotlighting: 10 person hours; Small mammal trapping: 99 trap nights | November 2010 | Unlikely. Heavily degraded and fragmented habitat unsuitable for the species. | Yes | Not required |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|---|---|---|---|--|---|--|-----------------|
| | | occupied due to fragmentation. | | | | | |
| Green and Golden Bell Frog <i>Litoria aurea</i> E-TSC Act V-EPBC Act | Breeding habitat comprises natural and constructed waterbodies including wetlands, stormwater detention basins, marshes, dams and streams-side, preferably those that are unshaded but with fringing vegetation. Forage for invertebrates within grassy habitats near breeding habitat. May shelter under vegetation, rocks and building materials such as fibro, sheet iron or bricks. | No. Waterbodies on the Amended Proposal Site are heavily degraded and have minimal instream vegetation and minimal or no fringing vegetation, which this species prefers. Mosquitofish (<i>Gambusia holbrooki</i>) are present in some of the ponds on site (PB 2014) which predate on Green and Golden Bell Frog tadpoles. | Call playback and night time water body searches – two sessions on separate nights in two locations with potential habitat, total 6 person hours. | November 2010 | Unlikely. Habitat is too degraded. The local population is considered likely to be extinct (White & Pyke 2010). | Yes | Not required |
| Koala <i>Phascolarctos cinereus</i> V-TSC Act V-EPBC Act | Species inhabits eucalypt woodlands and forests. The species feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. | Habitat present in native vegetation where Koala feed trees for the Central Coast management region were recorded including primary feed trees <i>E. parramattensis</i> | Call playback: 12 person hours over two nights; Spotlighting: 10 person hours over two nights. | November 2010 November/December 2018 (Cumberland Ecology) | Koala scats were recorded in the eastern portion of the Amended Proposal Site | Yes | Yes |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|---|---|--|--|------------------------|---|--|-----------------|
| | | and <i>E. tereticornis</i> . <i>E. baueriana</i> (secondary food tree in the region) was also recorded in low densities. | Rapid SAT – 1 day at 16 sites throughout the Amended Proposal Site and adjacent land (Cumberland Ecology) Total 5 days scat searches using scat detection dog (Cumberland Ecology) Total seven IR Cameras over 19 days/nights (Cumberland Ecology) | | | | |
| Regent Honeyeater <i>Anthochaera phrygia</i> CE-TSC Act E-EPBC Act | The Regent Honeyeater inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance | No. Woodland on the Amended Proposal Site does not contain habitat features this species prefers. The Amended Proposal Site does not support high abundances of birds or | Diurnal bird surveys: 8 person hours (2 sessions in each of 4 locations) | November 2010 | Unlikely. The Amended Proposal Site does not contain suitable habitat. No recent records (<20 years) of | Yes | Not required |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|--|---|--|---|------------------------|---|--|-----------------|
| | and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Only three known key breeding regions remaining: north-east Victoria, and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests. | a high diversity of species. | | | this species within 10 kilometres of the Amended Proposal Site. | | |
| Squirrel Glider <i>Petaurus norfolcensis</i> V-TSC Act | Inhabits Blackbutt-Bloodwood forest with heath understorey in coastal areas. Require abundant tree hollows for refuge and nest sites. Forages for nectar, sap, invertebrates and pollen. | Marginal habitat only present. One record at Holsworthy Military Reserve. If present, likely to be restricted to the Georges River Corridor as other areas | Call playback: 12 person hours over two nights; Spotlighting: 10 person hours over two nights; Small | November 2010 | Unlikely. The species was not found during targeted surveys. | Yes | Not required |

| Predicted species credit species | Habitat requirements (from TSPD) | Habitat presence on Amended Proposal Site? | Targeted survey effort/ methods | Targeted survey timing | Presence status | Can species withstand further loss? (as specified in TSPD) | Further action? |
|----------------------------------|----------------------------------|--|----------------------------------|------------------------|-----------------|--|-----------------|
| | | are too disturbed and fragmented. | mammal trapping: 99 trap nights. | | | | |

7.3 Aquatic species

PB (2014a) assessed the aquatic fauna habitats and potential presence of threatened species through habitat assessment and reference to aquatic surveys reported in Gehrke *et al.* (2004) and Hyder Consulting (2012).

The stretch of the Georges River adjoining the western edge of the Amended Proposal Site varies from approximately 40 to 50 metres in width and is characterised by sluggish water flow. The riverbank varies from very steep in the north to gently sloping in the south. Bank erosion is evident on parts of the very steep eastern bank of the river in the north of the site. The vegetation on the bank in this area is variable, being dominated by native shrubs in the north and mats of weedy vines and shrubby thickets of *Lantana camara* in the centre and south. Native emergent aquatic vegetation, mostly comprising *Typha orientalis* and *Phragmites australis*, occurs in patches along the river edge (PB 2014a).

The Georges River is a major permanently flowing waterway and is classified as Class 1 (major fish habitat) in accordance with the criteria of Fairfull and Witheridge (2003).

Seven common native fish species and two exotic fish species were previously recorded in the Georges River and Anzac Creek in the vicinity of the Amended Proposal Site by Gehrke *et al.* (2004) and Hyder Consulting (2012). No species currently listed under the NSW Fisheries Management Act 1994 (FM Act) were recorded in the catchment and none were considered likely to occur in the adjacent stretch of the Georges River by PB (2014a). Due to the degraded condition of the river, the native species that persist here are likely to consist of disturbance tolerant species which are less sensitive to alterations in environmental conditions than species restricted to relatively unmodified environments (PB 2014a).

There are two dragonfly species currently listed under the FM Act occurring in the Sydney basin:

- Adams Emerald Dragonfly (*Archaeophya adamsi*) - Endangered
- Sydney Hawk Dragonfly (*Austrocordulia leonardi*) - Endangered

Neither species is listed under the TSC Act or EPBC Act. The closest historical records of the Adams Emerald Dragonfly and the Sydney Hawk Dragonfly are respectively 35 km and 12.5 km from the Amended Proposal Site.

A Threatened Dragonfly Species Survey Plan (Arcadis 2016) was prepared in consultation with DPI Fisheries as part of the Concept Approval, i.e. not prepared as part of the now Amended Proposal. The objective of the plan is to determine the presence or absence of threatened dragonfly species listed under the FM Act on the Georges River, adjacent to the Amended Proposal Site.

Field assessment of potential dragonfly habitat was undertaken in September 2016 as part of the plan. The character of the Georges River within the survey area was found to be markedly different from known habitat for the targeted threatened dragonfly species. No habitats for threatened dragonfly species were detected in the survey area after an extensive ecological assessment, and it is considered highly unlikely that they occur in the surveyed area. No impact to threatened dragonflies is anticipated as a consequence of the Amended Proposal.

8 AVOID AND MINIMISE IMPACTS

The FBA requires consideration of the steps taken to avoid and minimise the direct and indirect impacts of a development proposal on biodiversity values. Section 8.3.2 of the FBA sets out guidelines for the avoidance and minimisation of impacts to biodiversity during all phases of the project life cycle, comprising:

- Site selection phase
- Planning phase
- Construction phase
- Operational phase.

8.1 Measures to avoid impacts

8.1.1 Site selection phase

The guidelines for site selection phase in sections 8.3.2.2 to 8.3.2.6 of the FBA and the biodiversity assessment process undertaken for the Amended Proposal are presented in Table 8-1.

Table 8-1 Site selection phase FBA guidelines for avoidance and minimisation of biodiversity impacts

| FBA section | FBA guidelines | Consistency of the Amended Proposal with FBA guidelines |
|-------------|---|---|
| 8.3.2.2 | Selecting a suitable development site for a Major Project or a route for linear projects, should be informed by knowledge of biodiversity values. An initial desktop assessment of biodiversity values would assist in identifying areas of native vegetation cover, EECs or CEECs, and potential habitat for threatened species. | A desktop assessment of the biodiversity values of the MPW Site was undertaken as part of a preliminary assessment of the MPW Project and as part of the Ecological Assessment for the MPW Concept Approval. |
| 8.3.2.3 | Stage 1 of the FBA will provide the preliminary information necessary to inform project planning. Early consideration of biodiversity values is recommended in site selection, or route selection for linear projects, and the planning phase. | Early consideration of biodiversity values was undertaken in preliminary assessments and in the Ecological Assessment for the MPW Concept Approval. |
| 8.3.2.4 | The site/route selection process should include consideration and analysis of the biodiversity constraints of the proposed development site and consider the suitability of the Major Project based on the types of biodiversity values present on the development site. | The scale and type of development provides only limited possibilities for the incorporation of small isolated patches of vegetation into the design of a large industrial and warehouse layout. It was acknowledged in the biodiversity assessments for the MPW Concept Approval (PB 2014a, 2015a and 2015b) that the MPW Project will involve clearing of threatened ecological communities, threatened |

| FBA section | FBA guidelines | Consistency of the Amended Proposal with FBA guidelines |
|-------------|--|--|
| | | <p>species and their habitat; however the majority of this vegetation/habitat is made up of small, highly fragmented and disturbed patches of vegetation. This remains the case for the Amended Proposal.</p> <p>.</p> |
| 8.3.2.5 | <p>When considering and analysing the biodiversity constraints for the purpose of selecting a development site, the following matters should be addressed:</p> <ul style="list-style-type: none"> (a) whether there are alternative sites within the property on which the proposed development is located where siting the proposed Major Project would avoid and minimise impacts on biodiversity values (b) how the development site can be selected to avoid and minimise impacts on biodiversity values as far as practicable (c) whether an alternative development site to the proposed development site, which would avoid adversely impacting on biodiversity values, might be feasible. | <p>There were limited alternative options for a viable intermodal facility within the area.</p> <p>The MPW Site represents an ideal position for an intermodal facility as:</p> <ul style="list-style-type: none"> ▪ The site is situated in close proximity to the SSFL, reducing the length of rail link needed and subsequently minimising potential vegetation clearing. ▪ There is a direct intersection linking the adjacent Moorebank Avenue to the M5 Motorway reducing the need for road works and subsequent additional biodiversity impacts. ▪ It is zoned as industrial land for use as industrial warehousing. ▪ Buffer zones are provided between the facility and nearby residential areas. ▪ It is within the freight catchment for which there is a freight demand, resulting in minimal use of road transport between origins / destinations and the IMT. <p>The location has also been identified in both state and federal strategies as the best and only location for an IMT facility to service a defined catchment in South-Western Sydney.</p> |
| 8.3.2.6 | <p>For linear projects, the route selection process must include consideration and an analysis of the biodiversity constraints of the various route options.</p> | <p>Not applicable – the MPW Project is not a linear shaped development under the definitions in the FBA.</p> |

| FBA section | FBA guidelines | Consistency of the Amended Proposal with FBA guidelines |
|-------------|---|---|
| | In selecting a preferred option, loss of biodiversity values must be weighed up and justified against social and economic costs and benefits. | |

The MPW Project has been granted Concept Approval in relation to the development of an intermodal facility, rail link and warehousing, and the MPW Site is accordingly considered suitable for the Amended Proposal.

8.1.2 Planning phase

The guidelines for planning phase in sections 8.3.2.7 to 8.3.2.8 of the FBA and the biodiversity assessment process undertaken for the Amended Proposal are presented in Table 8-2

Table 8-2 Planning phase FBA guidelines for avoidance and minimisation of biodiversity impacts

| FBA section | FBA guidelines | Consistency of the Amended Proposal with FBA guidelines |
|-------------|---|---|
| 8.3.2.7 | Once a suitable development site has been selected, further analysis of the biodiversity constraints of the proposed development site can then be used to inform concept planning, project siting and design. This includes the proposed location of temporary construction infrastructure such as roads, camps, stockpile sites and parking bays. | <p>The identified biodiversity constraints have been considered during the development of the MPW Project, and the potential biodiversity impacts of the Proposal have been assessed and approved within the MPW Concept Approval.</p> <p>Where biodiversity impacts from the Amended Proposal are additional to those considered to potentially occur in the MPW Concept Approval, these are further assessed in this BAR.</p> |
| 8.3.2.8 | <p>The Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value) or which avoid an EEC or CEEC. The following matters should be considered for this purpose:</p> <ol style="list-style-type: none"> siting of the project – the Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value score) or which avoid an EEC or CEEC. | <p>The total Amended Proposal Site is approximately 167 ha in area, of which 28% (or 47 ha) will be located in areas mapped as native PCTs. The vegetation to be impacted within the Amended Proposal Site has relatively low site value scores (refer to section 6.5 of this report) for each of the vegetation types below:</p> <ul style="list-style-type: none"> 29.69 to 56.25 for ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion; 33.33 for the ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion; and |

| FBA section | FBA guidelines | Consistency of the Amended Proposal with FBA guidelines |
|-------------|---|---|
| | | <ul style="list-style-type: none"> 56.25 for ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion. <p>In contrast, the condition of the remnant vegetation within the proposed offset areas within riparian vegetation to the west of the MPW Site is relatively good, as demonstrated by the higher current site value scores of 43-70 for these vegetation remnants (as determined in PB (2015b)).</p> <p>Extensive targeted surveys for the Koala have recorded only recent limited activity in the south eastern portion of the Amended Proposal Site. In contrast, current targeted surveys recorded evidence of more extensive Koala activity from the adjacent Bootlands. Given connectivity to known populations to the south it is feasible that the Bootlands may be the northern limit of extant Koala territories, however the Amended Proposal Site is likely to provide only occasional habitat for transient or dispersing Koalas.</p> |
| | <p>2. minimise the amount of clearing or habitat loss – the Major Project (and associated construction infrastructure) should be located in areas that do not have native vegetation, or in areas that require the least amount of vegetation to be cleared (i.e. the development footprint is minimised), and/or in areas where other impacts to biodiversity will be the lowest</p> | <p>Given the location and nature of the Amended Proposal and its context with regard to existing road and rail infrastructure, there is limited scope for using alternative locations to entirely avoid impacts on biodiversity. Given the scale and type of development, there are only limited possibilities for the incorporation of small isolated patches of vegetation into the design of a large industrial and warehouse development.</p> <p>The Amended Proposal has generally minimised the area of clearing and habitat loss to those areas of disturbed and fragmented patches of vegetation within the centre and east of the MPW Site, further consolidating the existing and proposed future industrial development area.</p> <p>For the Proposal, the 10 metre width allowed for drainage channels in the</p> |

| FBA section | FBA guidelines | Consistency of the Amended Proposal with FBA guidelines |
|-------------|---|---|
| | | <p>MPW Concept Approval was found to be inadequate for drainage of a catchment the size of the site without the risk of channel failure and/or significant scouring in a major rainfall event.</p> <p>Based on the number of stormwater basins proposed for the development, it was initially anticipated that four basin outlets would be required within the Georges River riparian corridor. Following discussions with the design team, the number of proposed basins, and corresponding outlets, has been reduced to three, and the width of the outlets has been reduced as far as practicable. The design of the basin outlets has incorporated features to facilitate fauna passage and outlets will be revegetated as far as is practicable while still maintaining functional flows.</p> <p>Every attempt was made to locate basin outlet channels in areas with minimal or highly degraded native vegetation; one is located where the existing main channel in the north of the site has catastrophically failed, resulting in major erosion and scouring and high cover of weeds including <i>Lantana camara</i> and <i>Ligustrum</i> spp. Another is predominantly located within the Dust Bowl, which currently does not support native vegetation.</p> <p>The key consideration when refining the design of basin outlet locations has been minimising impacts to riparian vegetation, where reasonable and feasible, in response to issues raised by NSW OEH during public exhibition of the Proposal.</p> |
| | <p>3. loss of connectivity – some developments can impact on the connectivity and movement of species through areas of adjacent habitat. Minimisation measures may include providing structures that allow movement of species across barriers or hostile gaps.</p> | <p>The Amended Proposal Site is located within an urban area and predominantly consists of Defence land, urban development, internal road network and a golf course. The majority of development of the MPW Site currently occurs on fragmented remnant vegetation within an urban environment and will not result in a change in connectivity.</p> <p>The MPW Site is connected to riparian vegetation along Georges River to the west which connects to extensive vegetation in the south and south east.</p> |

| FBA section | FBA guidelines | Consistency of the Amended Proposal with FBA guidelines |
|-------------|---|---|
| | | <p>The majority of the Georges River riparian corridor will be incorporated within the proposed offset areas, which through restoration and management will result in the likely improvement of habitat quality within this corridor and further consolidate the connectivity value of this corridor.</p> <p>The construction of basin outlets within the Georges River riparian corridor is likely to result in three gaps in the riparian vegetation, ranging in width. The approximate widths of the basin outlet impact areas during construction and operation (following revegetation) are as follows:</p> <ul style="list-style-type: none"> Basin 5: 40 to 72 metres during construction, and 25 to 72 metres during operation Basin 6: 41 metres during construction, and 22 metres during operation Basin 8: 52 metres during construction, and 30 to 50 metres during operation. <p>The revised design of the basin outlets is shown in Figure 8-1.</p> <p>It is proposed to design the outlets to facilitate fauna movement and avoid creating any additional barriers to terrestrial fauna.</p> <p>Recent evidence of Koala occurrence at the Amended Proposal site is considered to be transient or dispersing animals from the known Koala population to the south, or from potential Koala territories within the Bootlands to the east. Given the limited evidence of Koala occurrence at the site and existing barriers to dispersal to the north it is unlikely that the Amended Proposal Site provides a viable north – south habitat connectivity pathway for dispersing Koalas, and does not represent important linkage between areas of core Koala habitat outside of the Amended Proposal Site.</p> |
| | 4. other site constraints – any other constraints that the assessor has considered in determining the | The Amended Proposal has also considered the flood planning levels and Georges River riparian zone in the |

| FBA section | FBA guidelines | Consistency of the Amended Proposal with FBA guidelines |
|-------------|--|---|
| | siting and layout of the Major Project, e.g. bushfire protection requirements including clearing for asset protection zones, flood planning levels, servicing constraints. | development of the Amended Proposal layout, incorporating these areas into the Moorebank and Casula conservation areas. Where possible any new services will also be located adjoining existing service areas or within disturbed areas. |



LEGEND

- Amended Proposal site
- MPW Stage 2 site
- Moorebank Avenue site
- Native vegetation
- Existing railway
- Watercourse

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 Aerial imagery supplied by nearmap (Dec, 2018)



Figure 8-1 Sediment Basin Outlets

8.2 Unavoidable impacts

8.2.1 Construction phase

8.2.1.1 Construction program and activities

Subject to planning approval, construction of the Amended Proposal is planned to commence in the third quarter of 2017. The total period of construction works for the Amended Proposal is anticipated to be approximately 36 months.

The construction works have been divided into seven 'works periods' which are interrelated and also may potentially overlap. Subject to confirmation of construction staging, the order of these construction works periods may shift slightly.

A summary of the indicative activities included in each of these works periods, which is relevant to the construction of the IMT facility, the Rail link connection and the warehouses, is provided in Table 8-3.

Table 8-3 Works periods and activities

| Works period | Activities |
|---|--|
| Pre-construction fill placement and stockpiling | <ul style="list-style-type: none">• Establishment of temporary erosion and sediment controls• Minor clearing and grubbing of temporary stockpiling area• Establishment of a temporary stockpiling pad and associated temporary access roads• Installation of temporary construction compound, including amenities and office for bulk earthworks• Importation and placement of approximately 400,000 cubic metres (m³) of clean fill |
| Site preparation activities | <ul style="list-style-type: none">• Establishment of construction compound fencing and hoardings• Installation of temporary sediment and erosion control measures• Vegetation clearance• Installation of temporary site offices and amenities• Construction of hardstands for staff parking and laydown areas• Establishment of temporary batch plant sites and installation of batch plant• Construction of access roads, site entry and exit points and security (N.B. preference is to use existing access where practicable)• Set up of construction monitoring equipment |
| Bulk earthworks, drainage and utilities | <ul style="list-style-type: none">• Importation, stockpiling and placement of approximately 1,200,000 m³ of imported clean fill (Bulk Earthworks) and raising of the Amended Proposal Site to final level |

| Works period | Activities |
|---|---|
| | <ul style="list-style-type: none"> • Installation of OSDs • Drainage and utilities installation • Establishment of a concrete batching plant |
| Moorebank Avenue intersection works and internal road network | <ul style="list-style-type: none"> • Relocation, adjustment and/or protection of all affected utilities, services and signage, as required • Establishment of traffic management devices • Installation of erosion and sediment controls • Stripping and stockpiling of topsoil by excavators and trucks • Drainage works • Progressive stabilisation of exposed areas • Compaction of widening areas • Preparation of new lane surfaces • Forming of new kerbs, gutters, medians and other structures • Construction of asphalt and concrete pavement • Landscaping of exposed earthworks areas • New line marking, lighting and sign posting • Removal of construction traffic management and progressive opening of new works to traffic |
| IMT facility and Rail link connection construction | <ul style="list-style-type: none"> • Importation, placement and compaction of engineering fill • Compaction of engineering fill • Importation and placement of ballast material • Establish formwork and reinforcement for sidings and bridge infrastructure • Placement of concrete, curing and sealing • Installation of permanent ways and rail systems • Installation of permanent access gates, security gatehouse and permanent fencing • Installation of the connection between the Rail link and the IMT facility sidings • Erection of IMT facility administration building – excavation foundation and floor slab construction, structural wall and roof framework, and roofing • Internal fit-out of building with control room, office, workshops, loco-shifter and staff amenities |
| Construction and fit-out of warehousing | <ul style="list-style-type: none"> • Establishment of construction compound, temporary fencing/hoardings and temporary sediment and erosion control |

| Works period | Activities |
|---|--|
| | <ul style="list-style-type: none"> • Installation of temporary site offices and amenities • Excavation, foundation and floor slab installation • Erection of framework and structural walls • Installation of roof • Internal fit out • Landscaping and surrounds • Preparation of warehouse access road subgrade • Forming of new kerbs, gutters, medians and other structures • Construction of asphalt and concrete pavement • New line marking, lighting and sign posting • Removal of construction traffic management and progressive opening of the internal road and warehouse access roads to traffic |
| Miscellaneous structural construction and finishing works | <ul style="list-style-type: none"> ▪ Decommissioning/demobilisation of construction sites ▪ Commissioning of operational facilities ▪ Landscaping ▪ Rehabilitation of affected areas ▪ Post-construction condition surveys ▪ Removal of construction environmental controls ▪ Removal of construction ancillary facility related traffic signage |

8.2.1.2 Ancillary compounds

Temporary construction compounds, a batching plant and communal parking areas would be required to support construction works for the Amended Proposal. The locations of these compounds and facilities are indicative and subject to confirmation by the construction contractor and are shown Figure 8-2.

At this stage construction compounds identified for the Amended Proposal include:

- Earthworks Compound
- IMT Facility Compound
- Rail Compound.

Access to the compound sites would be via existing access points to the MPW Site from Moorebank Avenue. An area would be made available in the northern portion of the Amended Proposal Site to provide worker parking, once the Moorebank Avenue / Anzac Avenue intersection upgrade is complete. In addition, to the above compounds, individual smaller compounds would be established for the construction of each warehouse.

The indicative location of these compounds is shown in Figure 8-2. Compound and stockpile sites would be temporary in nature and removed/decommissioned at the completion of construction. Where not within the footprint of the operational area, these areas would be rehabilitated upon completion of the works and the sites left in a stable condition.

8.2.1.3 Stormwater Basin Outlets

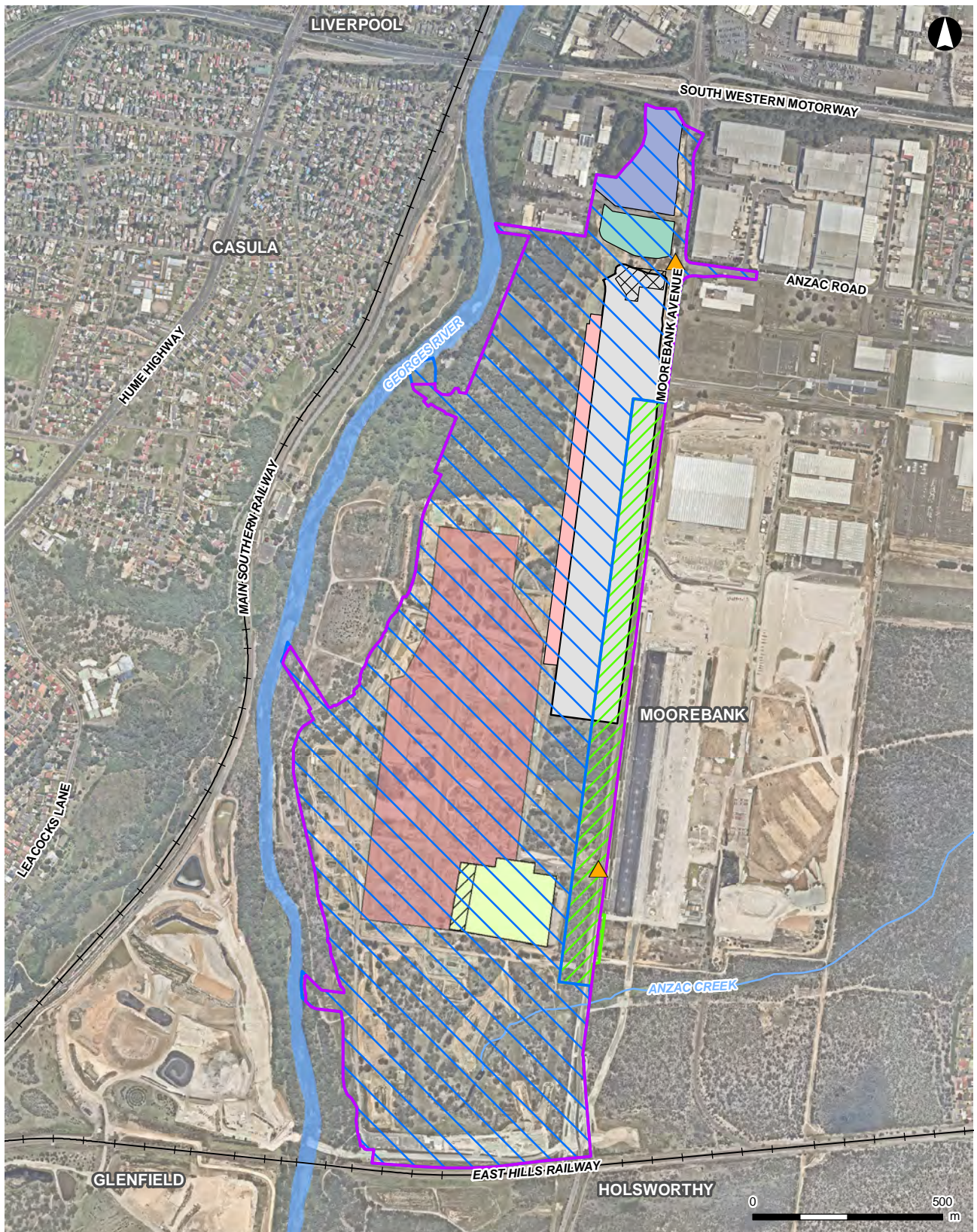
Each of the proposed basins (5, 6 and 8) discharging to the Georges River requires outlet channels that are:

- to be configured with energy dissipaters and scour protection, in traversing the overbank areas of the Georges River,
- are to be no higher than existing ground surface levels (to avoid adverse flood impacts); and
- aligned with no less than a 45 degree entry angle into the Georges River channel.

The outlet channels will include gabion and reno-mattress elements that accommodate grass and low vegetation.

The approximate widths of the basin outlet impact areas during construction and operation (following revegetation) are as follows (Figure 8-1):

- Basin 5: 40 to 72 metres during construction, and 25 to 72 metres during operation
- Basin 6: 41 metres during construction, and 22 metres during operation
- Basin 8: 52 metres during construction, and 30 to 50 metres during operation.



LEGEND

- | | | |
|--------------------------|---|--|
| Construction site access | Construction parking area | Earthworks compound |
| Amended Proposal site | IMT facility compound | Pre-construction & bulk earthworks stockpiling |
| MPW Stage 2 site | Rail and IMT compound | IMT facility area |
| Moorebank Avenue | Materials crushing and batch plant (Option 2) | Existing railway |
| Batch plant (option 1) | | Watercourse |

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 Coordinate System: GDA 1994 MGA Zone 56
 Aerial imagery supplied by nearmap (Dec, 2018)



Figure 8-2 Proposed works

8.2.1.4 Potential impacts on biodiversity

Likely impacts are those impacts that may arise as a result of unmitigated activities associated with the construction of the Amended Proposal. The impacts specified in point 12a) of the SEARs are considered below.

Endangered (and vulnerable) ecological communities

The Amended Proposal will require clearing of all vegetation within the Amended Proposal Site, including threatened ecological communities. The threatened ecological communities to be directly impacted and the total areas of impact are listed in Table 8-4.

Table 8-4 Areas of direct impact to threatened ecological communities

| Plant Community Type | Equivalent TEC | Conservation status | Direct Impact (area to be cleared) | | Total area of impact |
|---|---|---|------------------------------------|-----------------------|----------------------|
| | | | MPW Stage 2 Site | Moorebank Avenue Site | |
| Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (PCT ME003) | Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion | Vulnerable (TSC Act) Endangered (EPBC Act) | 9.81 ha | 3.73 ha | 13.54 ha |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (PCT ME005) | Castlereagh Swamp Woodland | Endangered (TSC Act) | 0.46 ha | 0.22 ha | 0.68 ha |
| Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018) | River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions | Endangered (TSC Act) | 27.88 ha | 0.59 ha | 28.47 ha |

Ecosystem credits are required to offset the impacts to these threatened ecological communities. The credit requirements are provided in Section 10.1.

Threatened flora and fauna species and their habitat

The Amended Proposal will have direct impacts on populations of four species credit threatened flora and fauna species listed under the TSC Act and EPBC Act. Table 8-5 summarises the impacts to these species.

Table 8-5 Impacts to threatened species

| Threatened species | Conservation status | Direct impact (number/area to be cleared) | | Total no./area to be cleared |
|--|---------------------|---|-----------------------|------------------------------|
| | | MPW Stage 2 Site | Moorebank Avenue Site | |
| <i>Persoonia nutans</i> | Endangered | 8 plants | 8 plants | 16 plants |
| <i>Grevillea parviflora</i> subsp. <i>parviflora</i> | Vulnerable | 254 stems | 79 stems | 333 stems |
| <i>Hibbertia puberula</i> subsp. <i>puberula</i> | Endangered | 0.94 ha | 1.06 ha | 2.00 ha |
| Koala <i>Phascolarctos cinereus</i> | Vulnerable | 38.15 ha | 4.54 ha | 42.69 ha |

Species credits are required to offset the impacts to these species. The credit requirements are provided in Section 10.1. No other threatened species listed under the TSC Act and/or EPBC Act are anticipated to be directly impacted by the Proposal.

The clearing of vegetation will result in the loss of specific fauna habitat components, including live trees, tree hollows, foraging resources, groundlayer habitats such as ground timber and well-developed leaf litter. These resources offer sheltering, foraging, nesting and roosting habitat to a variety of fauna, including threatened fauna, occurring within the locality. The Amended Proposal will require removal of 43 hollow-bearing trees.

The assessment of ecosystem credit species associated with PCTs on the Amended Proposal site found that one species (Little Eagle) is present, two threatened fauna species have a high likelihood of occurrence and 13 have a moderate likelihood of occurrence; species are listed in Section 7.1. Ecosystem credits are required to offset the impacts to these threatened fauna species; the credit requirements are provided in Section 10.1.

Groundwater dependent ecosystems

Impacts to groundwater dependent ecosystems, such as drawdown of groundwater from the root zone, may occur as a result of earthworks and geotechnical construction activities. This may have the potential to affect retained vegetation and habitat that may utilise the shallow groundwater aquifers present. The riparian vegetation in the west of the site has been identified as having high potential for groundwater interaction.

Direct Impacts on wildlife and habitat corridors and habitat fragmentation

Most of the habitat to be removed for the Amended Proposal is currently fragmented by the existing development. The vegetation in the riparian corridor adjoining the Georges River maintains connectivity with riparian vegetation to the north and south of the Amended Proposal Site and may facilitate the movement of less mobile species, including cover-dependent species, larger terrestrial mammals and arboreal mammals. The vegetation within the basin outlet locations is currently disturbed, with high abundance and cover of exotic species including invasive weedy species.

The riparian corridor would be directly impacted by the removal of vegetation for construction of sediment basin outlets in three locations. Vegetation would be removed to the water's edge, creating a temporary barrier to habitat connectivity along the riparian corridor; the resulting gaps in the vegetation would range from approximately 40 metres to 70 metres during construction. The areas to be disturbed would be recontoured and partially revegetated upon completion of the basin outlets to restore habitat connectivity.

These impacts are discussed further in Section 8.3.

Riparian land

Additional areas of riparian vegetation will be removed for the three basin outlets and the covered drain required for the Amended Proposal. This additional riparian vegetation amounts to a total of 1.56 hectares of Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin in addition to the area to be impacted identified in the MPW Concept Approval.

The retained riparian vegetation adjoining the Amended Proposal Site will be conserved and restored as part of biodiversity offsetting for the Amended Proposal, within the area known as the Moorebank Conservation Area (see Section 10). At its narrowest point, the setback of the Amended Proposal Site footprint from the vegetated river edge, as measured using GIS, is approximately 40 metres. The remainder of the retained riparian vegetation ranges in width up to 290m at its widest point.

Indirect impacts

The following indirect impacts to adjoining areas of biodiversity value in the Georges River riparian corridor may occur during construction and/or operation of the Amended Proposal.

- **Sedimentation and erosion:** Sedimentation and erosion resulting from fill placed in proximity to areas of retained vegetation has the potential to degrade the riparian vegetation. It is noted that some areas within the riparian zone, particularly those areas adjacent to existing drainage infrastructure, are currently subject to sedimentation and erosion impacts.
- **Noise, dust or light spill:**
 - Wildlife in the riparian zone adjoining the Amended Proposal Site is likely to be habituated to frequent noise exposure as a result of current activities on the site and in the locality. The construction phases of the Amended Proposal may cause temporary disturbance to animals using the riparian zone; the impacts from noise emissions are likely to be limited to areas

- close to the Amended Proposal Site and are not likely to have a significant, long-term, impact on wildlife populations in the region.
- Dust generated during construction may be deposited onto the foliage of adjacent native vegetation. This has potential to reduce photosynthesis, which may reduce the overall health of the vegetation adjacent to the Amended Proposal Site through changes to vegetation structure and composition.
 - Light pollution is likely to be substantially higher than current conditions during the construction and operation of the Amended Proposal due to fixed lighting within the facility and lighting from trucks and trains.
 - **Inadvertent impacts on adjacent habitat or vegetation:** in the short term, the Amended Proposal would result in increased edge effects on the habitat of the Georges River riparian corridor due to clearing. Given the relatively narrow width of this corridor and its high edge to area ratio, along with its clearing history, edge effects are currently severe in many patches.
 - **Feral pest, weed and/or pathogen encroachment into adjoining vegetation:**
 - The vegetation of the riparian corridor currently has a moderate to high level of weed invasion, particularly of woody and vine weeds. Weeds may be further dispersed into areas of native vegetation adjoining the Amended Proposal Site, particularly adjacent to cleared areas.
 - The habitat that would be removed for the Amended Proposal is already affected by pest species. Removal of this habitat would result in a reduction in habitat available to these species. In the short term this may lead to increased competition for resources (e.g. tree hollows) and increased pressure on remaining habitats.
 - There is potential for pathogens including Amphibian Chytrid Fungus, Exotic Rust Fungi and Phytophthora Root Rot Fungus to occur on the Amended Proposal Site at present or in the future. With the implementation of hygiene procedures for the use of vehicles and the importation of materials to the site, the risk of introducing or spreading these pathogens would be low.

8.2.1.5 Comparison with impacts of the MPW Concept Approval

The direct and indirect impacts of the Amended Proposal are largely similar in nature and extent to the impacts identified for the MPW Concept Approval by PB (2014a). Additional impacts to threatened species have been identified, as well as additional areas of riparian vegetation to be cleared for sediment basin outlets. A comparison of the impacts considered by PB (2014a) and the impacts of the Amended Proposal is presented in Table 8-6.

Table 8-6 Comparison of impacts assessed in PB (2014, 2015) and the impacts of the Amended Proposal.

| Impact | MPW Concept Approval impacts (full build) | Amended Proposal impacts |
|--------------------------------------|--|---|
| Vegetation clearing and habitat loss | Vegetation clearing would occur throughout the eastern part of the development site adjacent to Moorebank Avenue and would extend to the west through the middle of the site to the existing | Vegetation clearing would occur through similar areas as assessed in the MPW Concept Approval, with the exception of the rail crossing of the Georges River (subject to separate approval) and with a |

| Impact | MPW Concept Approval impacts (full build) | Amended Proposal impacts |
|---|---|--|
| | riparian vegetation corridor along the Georges River. Three sediment basin outlets intersecting the riparian corridor were assumed to require clearing of about 10 metres wide. | greater extent of clearing for the three sediment basin outlets and covered drain within the riparian zone adjoining the Georges River. Note some of the vegetation boundaries have been revised following the MPW Concept Approval to exclude areas of hardstand and cleared grassland dominated by exotic species. |
| Loss of roosting and breeding habitat in hollow bearing trees | Removal of over 43 hollow-bearing trees containing hollows of a wide variety of shapes and sizes, ranging from narrow cracks and fissures in dead wood, to hollows within tree trunks with very large entrance diameters (>300mm) and large internal volumes. The majority of the hollows that would be lost are in trees located in heavily cleared areas of the development site. | Similar impacts to those identified in the MPW Concept Approval – no additional hollow-bearing trees were identified in the additional riparian vegetation to be cleared. |
| Direct mortality | <p>Specimens of <i>Grevillea parviflora</i> subsp. <i>parviflora</i> and <i>Persoonia nutans</i> on the site would be killed during clearing unless a translocation program for these species is implemented.</p> <p>Fauna injury or death could occur as a result of the construction phase, particularly when vegetation is being cleared and existing detention basins filled.</p> | <p>An additional threatened plant species, <i>Hibbertia puberula</i> subsp. <i>puberula</i>, was identified on the Amended Proposal Site and will be directly impacted.</p> <p>The Koala was not identified during the MPW Concept Approval but was identified on the Amended Proposal Site during recent targeted surveys. Koala activity on the Amended Proposal Site is low and considered to be only transient or dispersing individuals rather than an extant population. Direct mortality of Koalas during construction is therefore considered unlikely.</p> <p>Clearing of threatened species habitat would occur through similar areas as assessed in the MPW Concept Approval, with the exception of the rail crossing of the Georges River (subject to separate approval) and with a greater extent of clearing for the three sediment basin outlets and covered drain within the riparian zone adjoining</p> |

| Impact | MPW Concept Approval impacts (full build) | Amended Proposal impacts |
|--|--|--|
| | | the Georges River. Note some of the vegetation boundaries have been revised following the MPW Concept Approval to exclude areas of hardstand and cleared grassland dominated by exotic species. |
| Loss of foraging resources | In addition to the displacement of resident animals and loss of shelter, vegetation clearing would result in the loss of potential foraging resources for species which shelter and breed outside the development site. This loss may impact highly mobile fauna species occurring in adjacent habitat. | <p>The Koala was not identified during the MPW Concept Approval but was identified on the Amended Proposal Site during recent targeted surveys. A species polygon has now been generated for the Koala on the Amended Proposal Site. Koalas occurring on the Amended Proposal Site are considered likely to be transient or dispersing individuals, and loss of foraging resources for this species is therefore considered to be minor.</p> <p>Impacts to foraging resources for other fauna are similar to those identified in the MPW Concept Approval – a similar area of foraging habitat is being removed.</p> |
| Fragmentation and loss of connectivity | <p>The MPW Project would result in the removal of a substantial area of woodland/forest habitat. This habitat is currently isolated/fragmented by existing rail infrastructure, internal and external roads, built and landscaped areas, sporting fields and a golf course.</p> <p>The MPW Project is not likely to significantly fragment or isolate retained vegetation along the Georges River Corridor. The proposed Rail link across the Georges River would create a break in the canopy of the riparian vegetation approximately 50 m in width.</p> <p>The proposed overland drainage channels which form part of the stormwater infrastructure for the MPW Project would result in minor (<10 m) wide gaps in the canopy in the short term; however vegetation restoration would restore canopy connectivity in the medium term to long term.</p> | <p>The Amended Proposal does not include the Rail link across the Georges River.</p> <p>The proposed stormwater basin outlets would be wider than considered in the MPW Concept Approval (which allowed for 10 metre wide drainage channels) and may result in further fragmentation of the riparian corridor. The covered drain proposed at the northern end of the MPW Site may also have additional minor fragmentation and connectivity impacts, however this is located in a largely cleared easement.</p> |

| Impact | MPW Concept Approval impacts (full build) | Amended Proposal impacts |
|------------------------|--|--|
| Increased edge effects | <p>As most patches of native vegetation across the development site would be entirely removed, there would be no increase in edge effects on these patches.</p> <p>In the short term, the MPW Project would result in increased edge effects on the habitat of the Georges River riparian corridor due to clearing, particularly for overland drainage infrastructure. Due to the relatively narrow width of this corridor and its high edge to area ratio, edge effects are already quite severe. The short-term increase in edge effects as a result of the MPW Project is, therefore, unlikely to significantly alter the present edge effects on this habitat.</p> | <p>Similar impacts to those identified in the MPW Concept Approval – changes to edge effects are limited to changes to the width and shape of the sediment basin outlets; edge effects from these outlets were previously considered as clearing for ‘overland drainage infrastructure’. The proposed stormwater basin outlets would be wider than considered in the MPW Concept Approval (which allowed for 10 metre wide drainage channels).</p> |
| Noise impacts on fauna | <p>The wildlife of the development site is likely to be habituated to frequent noise exposure as a result of current activities on and adjoining the site. While the construction phases of the MPW Project may cause temporary disturbance to animals, the impacts from noise emissions are likely to be localised close to development site (up to 100 m) and are not likely to have a significant, long-term, impact on wildlife populations.</p> | <p>Similar impacts to those identified in the MPW Concept Approval – noise levels are not anticipated to increase from that assessed in the Concept Approval.</p> |
| Light impacts to fauna | <p>Under present conditions there is little light pollution of the core habitat of the development site, within the vegetation along the Georges River. Light pollution is likely to be substantially higher during the construction and operation of the MPW Project due to fixed lighting within the facility and lighting from trucks and trains.</p> | <p>Same impacts as those identified in the MPW Concept Approval.</p> |
| Dust pollution | <p>Dust generated during construction may be deposited onto the foliage of adjacent native vegetation. This has potential to reduce photosynthesis, which may reduce</p> | <p>Same impacts as those identified in the MPW Concept Approval.</p> |

| Impact | MPW Concept Approval impacts (full build) | Amended Proposal impacts |
|---|--|--|
| | the overall health of the vegetation adjacent to the development site through changes to vegetation structure and composition. | |
| Introduction and spread of weeds, pests and pathogens | <p>The MPW Project has the potential to further disperse weeds into areas of native vegetation within the development site, particularly adjacent to cleared areas. The vegetation of the riparian corridor currently has a moderate to high level of weed invasion, particularly of woody and vine weeds.</p> <p>The habitat that would be removed for the MPW Project is already affected by pest species. Removal of this habitat would result in a reduction in habitat available to these species. In the short term this may lead to increased competition for resources (e.g. tree hollows) and increased pressure on remaining habitats.</p> <p>There is potential for pathogens including Amphibian Chytrid Fungus, Exotic Rust Fungi and Phytophthora Root Rot Fungus to occur on the site at present or in the future. With the implementation of hygiene procedures for the use of vehicles and the importation of materials to the site, the risk of introducing or spreading these pathogens would be low.</p> | Same impacts as those identified in the MPW Concept Approval. |
| Fire regimes | The development site has been identified as containing bushfire prone land. With the implementation of design and management measures, the risk of the project causing a change to fire regimes that would be detrimental to biodiversity is low. | Same impacts as those identified in the MPW Concept Approval. |
| Disturbance to aquatic habitat | Bridges would have multiple piers located both adjacent to the Georges River and within the Georges River floodplain. If possible, it is not intended to locate any bridge piers within the river channel itself. Impacts could include: possible disturbance to the substrate of the river or removal of | The Amended Proposal does not include the rail link across the Georges River, therefore impacts arising from the bridge construction are not applicable to the assessment of this application. There would be potential impacts to aquatic habitats in the Georges River as a result of vegetation |

| Impact | MPW Concept Approval impacts (full build) | Amended Proposal impacts |
|---|---|---|
| | <p>submerged or emergent aquatic vegetation; shading of aquatic vegetation; potential increases in turbidity from construction runoff; accidental spillage/leakage of construction materials; loss of fringing and riparian vegetation.</p> <p>The section of Anzac Creek on the development site would be removed, and flows redirected through stormwater detention basins on the development site. Removal of this creek was considered by PB (2014a) to be unlikely to result in a significant negative impact to the receiving waters of the remainder of Anzac Creek, as current inflows are likely to be polluted with fertilisers, pesticides and silt and would constitute only a small proportion of total inflows.</p> | <p>clearing for the proposed sediment basin outlets.</p> <p>Impacts to Anzac Creek would be the same as those identified in the MPW Concept Approval.</p> |
| Disturbance of groundwater dependent ecosystems | <p>Impacts to groundwater dependent ecosystems, such as drawdown of groundwater from the root zone, may occur as a result of earthworks and geotechnical construction activities. This may have the potential to affect retained vegetation and habitat that may utilise the shallow groundwater aquifers present. The Alluvial Woodland vegetation in the west of the site has been identified as having high potential for groundwater interaction.</p> | <p>Same impacts as those identified in the MPW Concept Approval.</p> |

8.2.2 Operational phase

As concluded by PB (2014a), most of the construction impacts on biodiversity would continue through to the operation of the Amended Proposal. The operational impacts on biodiversity will be reduced once mitigation measures are implemented and the revegetation and restoration works within the adjoining conserved riparian vegetation progress.

In addition to the above identified impacts during construction, there is potential for alteration and reduction in surface water flows during operation, due to any run-off from the raised ground level of the Amended Proposal being directed into drainage infrastructure (pit and pipe arrangement and/or detention basins), and away from retained native vegetation.

8.3 Impacts requiring further consideration

Under the FBA, certain impacts on biodiversity values require further consideration by the relevant consent authority. These are impacts that are considered to be complicated or severe, and a decision will be made by the relevant consent authority on whether it is appropriate for these impacts to occur, and whether additional offsets, supplementary measures or other actions may be required.

Impacts that require further consideration include:

- Impacts that will substantially reduce the width of vegetation in the riparian buffer zone bordering rivers and streams 4th order or greater.
- Impacts in state biodiversity links.

The Georges River is at least a 6th order stream. The area within 50 metres of the Georges River is defined as a state biodiversity link under the FBA, and several sections of this area would be subject to impacts from the Amended Proposal.

The Georges River riparian corridor state significant biodiversity link would be impacted by the removal of vegetation for construction of sediment basin outlets in three locations, as well as an additional covered drain in the north of the riparian zone within the Endeavour Energy easement. Vegetation would be removed to the water's edge, creating a temporary barrier to habitat connectivity along the riparian corridor.

The vegetation within the basin outlet locations is currently disturbed, with high abundance and cover of exotic species including invasive weedy species such as *Lantana camara*, *Ligustrum* spp., *Cardiospermum grandiflorum* and *Arundo donax*.

The existing drainage infrastructure in the location of the proposed basin outlet 5 has catastrophically failed, resulting in an incised and scoured drainage line on the steep slope down to the Georges River, and there is dense cover of *Lantana camara* on the slope.

The vegetation in the Endeavour Energy easement at the northern extent of the riparian corridor on the Amended Proposal Site is largely cleared of native vegetation and supports a regularly mown/slashed grassland. At the western end of the easement is a steep, eroded slope supporting scattered native trees and shrubs.

The outlets have been designed to provide a long-term, engineered solution to the existing and proposed drainage issues in the local catchment and to prevent further impacts to the Georges River. Without the outlets, there would be a risk of major scouring and erosion of the river banks, and loss and degradation of native vegetation. This is illustrated by the existing drainage scenario on the site, with severe bank erosion and dominance by weedy exotic species at the existing main outlet. Further north, another drainage outlet was observed to have caused considerable erosion on the steep bank of the river.

Notwithstanding the above, a review of the width of the drainage channels has been undertaken as part of the Amended Proposal. The design of the channels has been reassessed with a view to reducing the footprint, and therefore reducing the clearing required.

The design of the northern channel has been refined to reduce vegetation clearing, and a maintenance access road has been removed from the central channel to reduce its width. The reduction in widths to these two channels has resulted in a reduction in the associated vegetation clearance at these areas.

The approximate widths of the basin outlet impact areas during construction and operation (following revegetation), and consequent gaps in the riparian corridor vegetation, are as follows (Figure 8-1):

- Basin 5: 40 to 72 metres during construction, and 25 to 72 metres during operation
- Basin 6: 41 metres during construction, and 22 metres during operation
- Basin 8: 52 metres during construction, and 30 to 50 metres during operation.

The areas to be disturbed would be re-contoured and partially revegetated upon completion of the basin outlets to restore habitat connectivity. While there would be a temporary and short term impact during construction of the outlets, the permanent impacts would be unlikely to significantly impede fauna movement provided that connectivity is enhanced using strategic revegetation and other fauna habitat features such as rocks and hollows logs to provide cover in these areas.

The impacts to the Georges River Riparian Corridor (Figure 5-2) are considered unlikely to fall into the category of impacts requiring further consideration as they:

- Will not result in a gap greater than 100 metres between two areas of moderate to good condition native vegetation with a patch size greater than 1 ha.
- Will not remove over-storey cover and mid-storey cover vegetation within the state significant biodiversity link to create a gap in over-storey cover vegetation greater than 100 metres.
- Will not create a hostile barrier within the state significant biodiversity link.

8.4 Cumulative impacts

There are three additional major approved and proposed developments within the immediate vicinity of the Amended Proposal: the MPE Stage 1 Project, the MPE Stage 2 Project and the Glenfield Recycling Facility.

The development of the three adjoining sites (MPE Stage 1, MPE Stage 2 and Glenfield Waste facility) would reduce or remove a range of biodiversity values, including available fauna habitat (roosting, nesting and foraging habitat), potential threatened fauna habitat, threatened plant species, TECs, local provenance plant species and potential seedbanks.

The Glenfield Waste Facility proposal requires clearing of 9.5 hectares of the PCT Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain,

Sydney Basin Bioregion, which forms part of the Critically Endangered Ecological Community (CEEC) Cumberland Plain Woodland, listed under the EPBC Act and TSC Act. As the Amended Proposal does not impact on Cumberland Plain Woodland, cumulative impacts on this TEC as a result of the Amended Proposal are not predicted.

The total impacts to native vegetation, including TECs, are detailed in Table 8-7.

Table 8-7 Cumulative impacts to native vegetation from the Amended Proposal, MPE Stage 1 Project and MPE Stage 2 Proposal

| Plant Community Type | Equivalent TEC | Area impacted by Amended Proposal | | Area impacted by MPE stage 1 | Area impacted by MPE Stage 2* | Total area of impact |
|--|---|---------------------------------------|--|------------------------------|-------------------------------|----------------------|
| | | Area impacted in the MPW Stage 2 Site | Area impacted in the Moorebank Avenue Site | | | |
| Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion | Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion Endangered (TSC Act) Critically Endangered (EPBC Act) | 0 ha | 0 ha | 0 ha | 0.05 ha | 0.05 ha |
| Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin | Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion Vulnerable (TSC Act) Endangered (EPBC Act) | 9.81 ha | 3.73 ha | 0.74 ha | 0.1 ha | 14.38 ha |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | Castlereagh Swamp Woodland Endangered (TSC Act) | 0.46 ha | 0.22 ha | 0.05 ha | 0 ha | 0.73 ha |

| Plant Community Type | Equivalent TEC | Area impacted by Amended Proposal | | Area impacted by MPE stage 1 | Area impacted by MPE Stage 2* | Total area of impact |
|---|--|---------------------------------------|--|------------------------------|-------------------------------|----------------------|
| | | Area impacted in the MPW Stage 2 Site | Area impacted in the Moorebank Avenue Site | | | |
| Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions Endangered (TSC Act) | 27.88 ha | 0.59 ha | 0.41 | 0 ha | 28.88 ha |
| Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion | Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions Endangered (TSC Act) | 0 ha | 0 ha | 0.03 ha | 0 ha | 0.03 ha |
| Total area of native vegetation cleared | | 38.15 ha | 4.54 ha | 1.23 ha | 0.15 ha | 44.07 ha |

*Excluding Moorebank Avenue Site

The Amended Proposal will have direct impacts on populations of four species credit threatened flora and fauna species listed under the TSC Act and/or EPBC Act. Three of these species were also recorded on the MPE Stage 1 Project Site and two were also recorded on the MPE Stage 2 Proposal Site. A summary of the impacts to species credit threatened flora and fauna species from the Amended Proposal and the MPE Project is shown in Table 8-8.

Table 8-8 Cumulative impacts to threatened species from the Amended Proposal, MPE Stage 1 Project and MPE Stage 2 Proposal

| Threatened species | Conservation Status | Amended Proposal impacts | | MPE Stage 1 impacts | MPE Stage 2 Site impacts* | Total impacts |
|--|---------------------------------|--------------------------|-------------------------------|---------------------|---------------------------|---------------|
| | | MPW Stage 2 Site impacts | Moorebank Avenue Site impacts | | | |
| <i>Persoonia nutans</i> | Endangered (EPBC Act, TSC Act) | 8 plants | 8 plants | 11 plants | 4 plants | 31 plants |
| <i>Grevillea parviflora</i> subsp. <i>parviflora</i> | Vulnerable (EPBC Act, TSC Act) | 254 stems | 79 stems | 20 stems | 0 stems | 353 stems |
| <i>Hibbertia fumana</i> | Critically endangered (TSC Act) | 0 ha | 0 ha | 0.26 ha | 0 ha | 0.26 ha |
| <i>Hibbertia puberula</i> subsp. <i>puberula</i> | Endangered (TSC Act) | 0.94 ha | 1.06 ha | 0.74 ha | 1.43 ha | 4.17 ha |
| <i>Koala</i> <i>Phascolarctos cinereus</i> | Vulnerable (EPBC Act, TSC Act) | 38.15 ha | 4.54 ha | 0 ha | 0 ha | 42.69 ha |

*Excluding Moorebank Avenue Site

Two threatened ecosystem credit fauna species have a high likelihood of occurrence and 11 have a moderate likelihood of occurrence on the Amended Proposal site. Given the modified and fragmented nature of fauna habitat in the Amended Proposal Site, potential impacts on these species are considered likely to be minimal, and mainly comprise removal of marginal foraging, sheltering and roosting habitat. As a result, cumulative impacts to threatened fauna species from the Amended Proposal are considered to be unlikely.

9 MITIGATION OF IMPACTS

Biodiversity impacts cannot be avoided for many aspects of the Amended Proposal. As such, the measures in Table 9-1 should be implemented to mitigate these impacts during construction and operation.

Table 9-1 Measures to be implemented to minimise impacts on biodiversity

| Mitigation measure | Outcome | Timing | Responsibility |
|--|--|--|---|
| <p>Following detailed design and before construction, detailed flora and fauna mitigation measures would be developed and presented as part of the CEMP. These detailed measures would incorporate the measures listed below.</p> <p>The CEMP would address:</p> <ul style="list-style-type: none"> • general impact mitigation; • staff/contractor inductions; • vegetation clearing protocols; • pre-clearing surveys and fauna salvage/translocation; • rehabilitation and restitution of adjoining habitat; • weed control; • pest management; and • monitoring. | <p>Flora and fauna would be managed in accordance with the requirements of the CEMP.</p> | <p>Pre-construction and construction</p> | <p>Design contractor, construction contractor</p> |

| Mitigation measure | Outcome | Timing | Responsibility |
|---|--|--|---|
| <p>The plans would include clear objectives and actions for the Proposal including how to:</p> <ul style="list-style-type: none"> • minimise human interferences to flora and fauna; • minimise vegetation clearing/disturbance; • minimise impact to threatened species and communities; • minimise impacts to aquatic habitats and species; and • undertake flora and fauna monitoring at regular intervals. | | | |
| <p>A Koala Management Plan (KMP) would be developed for the Moorebank Precinct. The plan will address:</p> <ul style="list-style-type: none"> • appropriate fencing to exclude Koalas during construction; • measures to avoid or minimise direct mortality of Koalas; | <p>Koalas would be managed in accordance with the requirements of the KMP.</p> | <p>Pre-construction and construction</p> | <p>Design contractor, construction contractor</p> |

| Mitigation measure | Outcome | Timing | Responsibility |
|---|--|-----------------------------------|--|
| <ul style="list-style-type: none"> • preclearance and ecologist clearing supervision requirements for Koalas; and • Koala management and translocation protocols. | | | |
| Vegetation clearing would be restricted to the construction footprint and sensitive areas would be clearly identified as exclusion zones. | Prevention of over clearing of vegetation | Pre-construction and Construction | Design contractor, construction contractor |
| The exclusion zones would be marked on maps, which would be provided to contractors, and would also be marked on the ground using high visibility fencing (such as barrier mesh). | Prevention of over clearing of vegetation | Pre-construction and Construction | Design contractor, construction contractor |
| A suitably qualified ecologist would accompany clearing crews to ensure disturbance is minimised and to assist in relocating any native fauna to adjacent habitat. | Prevention of over clearing of vegetation and fauna injury/mortality | Construction | Construction contractor |

| Mitigation measure | Outcome | Timing | Responsibility |
|---|---------------------------------|--------------|-------------------------|
| <p>The following procedures would be implemented to minimise fauna impacts from vegetation clearance:</p> <ul style="list-style-type: none"> • A staged habitat removal process would be developed and would include the identification and marking of all habitat trees in the area. • Where reasonable and feasible, clearing of hollow-bearing trees would be undertaken in March and April when most microbats are likely to be active (not in torpor) but are unlikely to be breeding or caring for young, and when threatened hollow-dependent birds in the locality are also unlikely to be breeding. • Pre-clearing surveys would be conducted 12 to 48 hours before vegetation clearing to search for native wildlife (e.g. reptiles, frogs, Cumberland Land Snail) that can be captured and relocated to the retained riparian vegetation of the Georges River corridor. | Prevents fauna injury/mortality | Construction | Construction contractor |

| Mitigation measure | Outcome | Timing | Responsibility |
|---|---------|--------|----------------|
| <ul style="list-style-type: none"> Vegetation would be cleared from a 10 m radius around habitat trees to encourage animals roosting in hollows to leave the tree. A minimum 48 hour waiting period would allow animals to leave. After the waiting period, standing habitat trees would be shaken (where safe and practicable) under the supervision of an ecologist to encourage animals roosting in hollows to leave the trees, which may then be felled, commencing with the most distant trees from secure habitat. Felled habitat trees would either be immediately moved to the edge of retained vegetation, or left on the ground for a further 24 hours before being removed from the construction area, at the discretion of the supervising ecologist. All contractors would have the contact numbers of wildlife rescue groups and would be instructed to coordinate with these groups in | | | |

| Mitigation measure | Outcome | Timing | Responsibility |
|---|--|--------------|-------------------------|
| relation to any animal injured or orphaned during clearing. | | | |
| <p>Within areas of high quality intact native vegetation proposed to be removed:</p> <ul style="list-style-type: none"> • Topsoil (and seedbank) is to be collected from native vegetation that are to be permanently cleared and used in the revegetation of riparian areas; and • Native plants in areas that are to be permanently cleared are to be relocated and transplanted in riparian areas identified for rehabilitation, where practicable | Conservation of genetic material from local native plant communities | Construction | Construction contractor |
| Unexpected finds of Cumberland Plain Land Snail or other threatened fauna will require consultation with OEH prior to relocation to adjacent retained habitat or alternative designated release sites as advised by OEH. | Prevents injury/mortality of threatened fauna | Construction | Construction contractor |

| Mitigation measure | Outcome | Timing | Responsibility |
|--|---|------------------------------------|-------------------------|
| Relocation of non-threatened fauna to adjacent retained habitat would be undertaken by an ecologist during the supervision of vegetation removal. | Prevents fauna injury/mortality | Construction | Construction contractor |
| An ecologist would supervise the drainage of any waterbodies on the Amended Proposal Site and would relocate native fish (e.g. eels), tortoises and frogs to the edge of the Georges River and/or the existing pond at the northern end of the Amended Proposal Site. | Prevents fauna injury/mortality | Construction | Construction contractor |
| The design of site fencing would consider the potential for entry of Koalas onto the site or entrapment of Koalas already present on site. Appropriate site boundary fencing shall be used to prevent Koala entry to the site from adjacent land while allowing any Koalas present to exit the site. Appropriate | Prevents injury/mortality of Koalas and other fauna on site | Detailed design & Pre-construction | Design contractor |

| Mitigation measure | Outcome | Timing | Responsibility |
|---|--|------------------------------------|--|
| <p>boundary fence design shall be specified in the KMP and may include using a strip of Colorbond or Perspex sheeting on the outside face of fencing to prevent Koalas from climbing the fence from outside of the site.</p> <p>The design of site fencing and any overhead powerlines would consider the potential for collision by birds and bats and minimise this risk where practicable.</p> | | | |
| The potential for translocation of threatened plant species as individuals or as part of a soil translocation process would be considered during the detailed development of the CEMP. | Reducing impacts to threatened plant species | Detailed design & Pre-construction | Design contractor, construction contractor |
| Important habitat elements (e.g. large woody debris) would be moved from the construction area to locations within the conservation area which would not be cleared during the Proposal, or to | Retaining fauna habitat resources | Pre-construction and Construction | Design contractor, construction contractor |

| Mitigation measure | Outcome | Timing | Responsibility |
|--|---|--|--|
| stockpiles for later use in vegetation/habitat restoration. | | | |
| Winter-flowering trees would be preferentially planted in landscaped areas of the Amended Proposal Site to provide a winter foraging resource for migratory and nomadic nectar-feeding birds and the Grey-headed Flying-fox. | Maintaining and enhancing fauna habitat resources | Detailed design, Pre-construction and Construction | Design contractor, construction contractor |
| Erosion and sediment control measures such as silt fencing and hay bales would be used to minimise sedimentation of streams and resultant impacts on aquatic habitats and water quality. | Prevention of sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats | Pre-construction and Construction | Design contractor, construction contractor |
| Opportunities for planting of detention basins with native aquatic emergent plants and fringing trees would be explored in the detailed design of the Amended Proposal and, if practicable, implemented so that they would provide similar habitat in the medium term to | Maintain aquatic habitat values | Pre-construction | Design contractor, construction contractor |

| Mitigation measure | Outcome | Timing | Responsibility |
|--|--|--|---|
| that lost through the removal of existing basins. | | | |
| The CEMP (or equivalent) would include detailed measures for minimising the risk of introducing weeds and pathogens. | Prevention of weed establishment and invasion | Pre-construction | |
| The CEMP and OEMP for the Proposal would consider and have reference to the weed removal and riparian vegetation restoration undertaken within parts of the Georges River corridor under the MPW Concept Approval (identified within the Biodiversity Offset Package for the MPW Project). | Prevention of weed establishment and invasion | Pre-construction, construction and operation | Design contractor, construction contractor, operations contractor |
| The detailed design process would consider the potential groundwater impacts on groundwater-dependent ecosystems. In most cases, these impacts would be mitigated at the design phase. | Prevention of impacts to groundwater-dependent ecosystems. | Detailed design & Pre-construction | Design contractor, construction contractor, operations contractor |

| Mitigation measure | Outcome | Timing | Responsibility |
|--|---|--|---|
| The OEMP would include a biodiversity monitoring program designed to detect operational impacts of the Georges River riparian corridor (within the offset site). | Minimise impacts to native riparian vegetation, retains habitat connectivity and improves native biodiversity values along riparian corridor of the Georges River | Pre-construction, construction and operation | Design contractor, construction contractor, operations contractor |
| Ongoing monitoring of macroinvertebrate communities will be undertaken prior to, during and following construction upstream and downstream of the proposed impacts at the proposed basin outlets in the Georges River and reference locations to assist in identifying any changes in aquatic communities. | Minimise impacts to the aquatic environment in the Georges River. | Pre-construction, construction and operation | Design contractor, construction contractor, operations contractor |
| The proposed stormwater outlets would be designed to minimise biodiversity impacts by incorporating native revegetation and fauna habitat features as possible. | Maintaining native vegetation values and fauna connectivity in basin outlets (which are located within the | Pre-construction | Design contractor |

| Mitigation measure | Outcome | Timing | Responsibility |
|--|--|----------------------------|--|
| | proposed conservation area) | | |
| The native vegetation and connectivity values in the proposed basin outlets would be monitored to ensure that fauna passage is maintained. | Maintaining native vegetation values and fauna connectivity in basin outlets (which are located within the proposed conservation area) | Construction and operation | Construction contractor, operations contractor |

10 OFFSETTING IMPACTS

10.1 Offset credit requirements

Under the *NSW Biodiversity Offsets Policy for Major Projects*, a biobanking agreement is required to be used to secure an offset site. The direct offsets for threatened species and communities impacted by the Amended Proposal will be delivered through the establishment of a Biobanking site/s to offset the broader proposal impacts under the NSW Biobanking scheme.

A Biobanking agreement application has been submitted to, and is currently being assessed by, the NSW Office of Environment and Heritage. The proposed Biobanking agreement will provide funded management actions, monitoring and long-term security of the Biobank site in-perpetuity.

Upon execution of the Biobanking agreement, the appropriate number of Biobanking credits generated from the Biobank site to offset the impacts of the Amended Proposal will be retired. Should additional credits, not available on the offset sites included in the Biobanking Agreement, be required these would be sourced from the market or additional offset sites outside the Moorebank Precinct.

It should be noted that the impacts to PCTs and threatened species in the Moorebank Avenue Site have been assessed in the MPE Stage 2 BAR prepared by Arcadis (2017b). The Moorebank Avenue Site is generally located within the larger MPW Stage 2 Proposal Site.

The offset requirements related to values in the Moorebank Avenue Site may be included within the offset package for either the MPE Project or the MPW Project, subject to the timing of determination of the MPW Stage 2 Proposal (Amended Proposal) and the MPE Stage 2 Proposal.

Offset credit requirements were calculated using the FBA calculator, by Jane Rodd (Assessor No. 0023) for the Amended Proposal. Separate calculations were undertaken for areas within the MPW Stage 2 Site and the Moorebank Avenue Site; the offset requirements for the impacts within the Moorebank Avenue Site were calculated as part of the MPE Stage 2 proposal.

The full credit report for the MPW Stage 2 Site is provided in Appendix A. The full credit report for the MPE Stage 2 Proposal, which includes the Moorebank Avenue Site, is included in Arcadis (2017b).

10.1.1 Impacts on native vegetation

Loss of landscape and site value for each PCT identified on the Amended Proposal Site and its associated ecosystem species, as determined using the credit calculator, is presented in Table 10-1. The PCTs to be offset are shown in Figure 6-2.

Table 10-1 Impact summary for PCTs and associated ecosystem credit species requiring offsets and their required credits

| Vegetation zone | Associated TECs and/or Threatened Species | Area to be impacted | Loss in landscape value | Loss in site value score | Credits required |
|--|--|---------------------|-------------------------|--------------------------|------------------|
| MPW Stage 2 Site | | | | | |
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003): Moderate/Good | Castlereagh Scribbly Gum Woodland of the Sydney Basin bioregion (VEC) <i>Persoonia nutans</i> <i>Grevillea parviflora subsp. parviflora</i> <i>Hibbertia puberula subsp. puberula</i> | 9.81 ha | 27.5 | 56.25 | 371 |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (ME005): Moderate/Good | Castlereagh Swamp Woodland (EEC) | 0.46 ha | 27.5 | 33.33 | 15 |
| Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018): Moderate/Good | River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions (EEC) | 23.94 | 27.5 | 56.25 | 1107 |

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| Vegetation zone | Associated TECs and/or Threatened Species | Area to be impacted | Loss in landscape value | Loss in site value score | Credits required |
|---|---|---------------------|-------------------------|--------------------------|------------------|
| Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018): Moderate/Good - Poor | River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions (EEC) | 3.94 | 27.5 | 29.69 | 182 |

Moorebank Avenue Site

| | | | | | |
|---|--|---------|------|-------|-----|
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003): Moderate/Good - Medium | Castlereagh Scribbly Gum Woodland of the Sydney Basin bioregion (VEC) <i>Persoonia nutans</i> <i>Grevillea parviflora subsp. parviflora</i> <i>Hibbertia puberula subsp. puberula</i> | 3.73 ha | 27.5 | 55.73 | 140 |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (ME005): Moderate/Good - Medium | Castlereagh Swamp Woodland (EEC) | 0.22 ha | 27.5 | 33.33 | 7 |
| Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the | River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South- | 0.59 | 27.5 | 34.38 | 27 |

| Vegetation zone | Associated TECs and/or Threatened Species | Area to be impacted | Loss in landscape value | Loss in site value score | Credits required |
|--|---|---------------------|-------------------------|--------------------------|------------------|
| Cumberland Plain, Sydney Basin (ME018): Moderate/Good - Medium | east Corner bioregions (EEC) | | | | |

10.1.2 Impacts on threatened species

Impacts to threatened species credit species and their associated species credits are summarised in Table 10-2. The full credit report is provided in Appendix A.

Table 10-2 Impact summary for threatened species credit species requiring offsets and their required credits

| Scientific name | Status | Impacts | Credits required for MPW Stage 2 Site | Credits required for Moorebank Avenue Site | Total number of credits required for Amended Proposal |
|--|------------|-----------|---------------------------------------|--|---|
| <i>Persoonia nutans</i> Nodding Geebung | Endangered | 16 plants | 616 | 616 | 1,232 |
| <i>Grevillea parviflora</i> subsp. <i>parviflora</i> Small-flowered Grevillea | Vulnerable | 333 stems | 3,556 | 1,106 | 4,662 |
| <i>Hibbertia puberula</i> subsp. <i>puberula</i> | Endangered | 2.00ha | 38 | 43 | 81 ³ |
| Koala <i>Phascolarctos cinereus</i> | Vulnerable | 42.69ha | 992 | 118 | 1,110 |

10.2 Offset site identification

The proposed biobank sites (Moorebank Offset Areas) to be established under the proposed Biobanking Agreement comprises of three biodiversity offset areas, as outlined below:

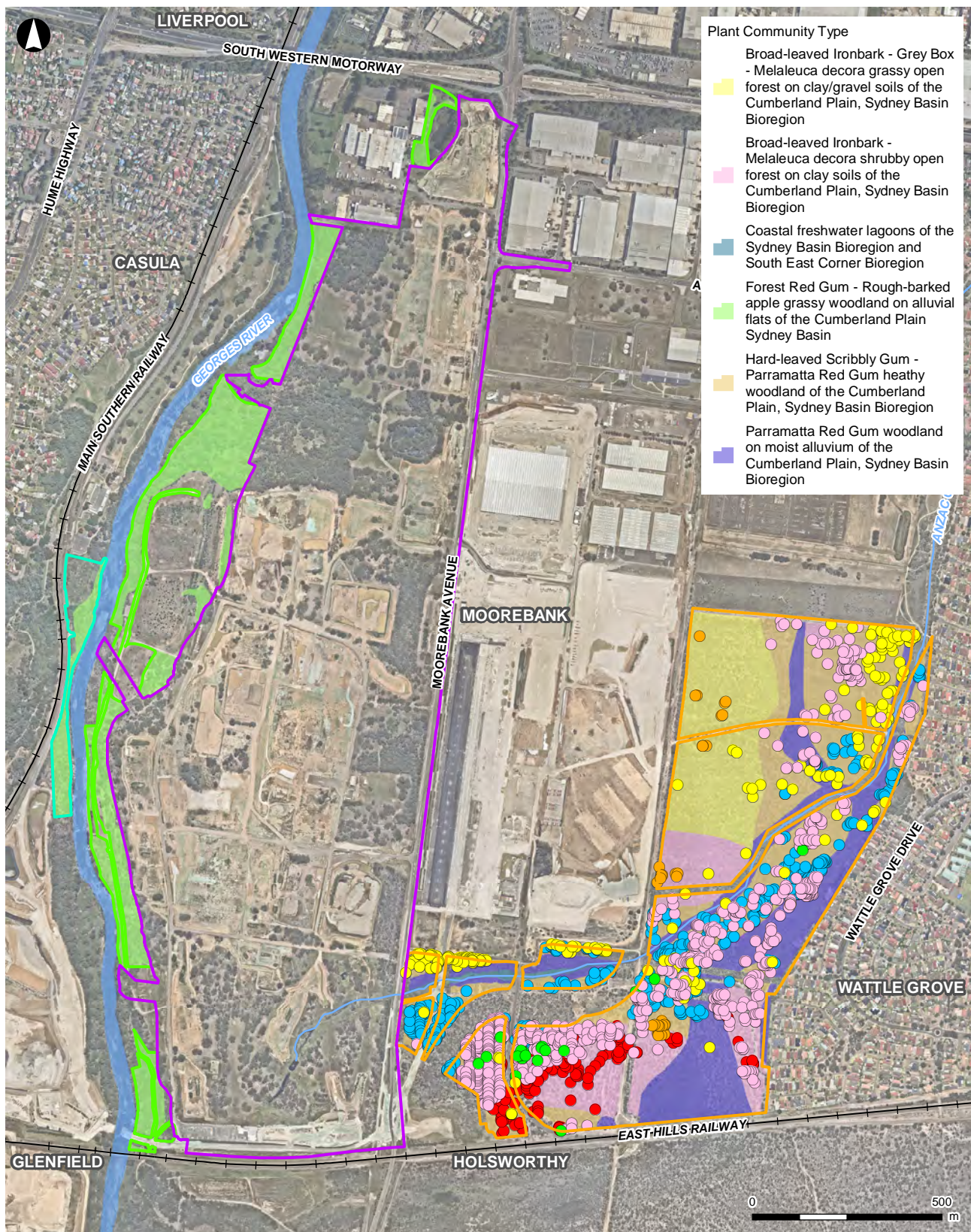
- Wattle Grove Offset Area – management to maintain or improve the condition of vegetation and habitat of native vegetation (approximately 82.1 hectares) within part of the eastern portion of Lot 4 DP 1197707 (the Boot land) east of Moorebank Avenue, which adjoins the East Hills Railway Line to the south, land owned by the

³ The credit reports are provided in Appendix A. Note that only whole numbers can be entered into the credit calculator. It is known that the calculator applies an offset requirement of 40 credits per hectare therefore this rate has been used to calculate the requirement for decimals of a hectare.

SIMTA consortium to the northwest, and the residential area of the Wattle Grove to the east.

- Moorebank Offset Area – Georges River riparian zone: restoration and management of the Georges River riparian zone (approximately 24.8 hectares) including the eastern side of the river corridor from approximately 300 metres south of the M5 Motorway for a length of approximately 2.5 km south of the East Hills Railway Line within part of Lot 1 DP 1197707 and part of Lot 100 DP 1049508.
- Casula Offset Area (also referred to as the 'hourglass land'): restoration and management of vegetation within part of Lot 4 DP 1130937 which is an irregular shaped allotment (approximately 3.2 hectares) on the western side of the Georges River.

The proposed Moorebank Offset Area adjoins the Georges River and are located immediately adjacent to the western boundary of the area impacted by the Amended Proposal. The Wattle Grove Offset Area is located immediately adjacent to the southern section of the eastern boundary of the Amended Proposal Site, adjoining Moorebank Avenue. The Casula Offset Area is located on the western side of the Georges River, approximately 40 metres west of the Amended Proposal Site. The proposed biobank sites (Moorebank Offset Areas) are shown on Figure 10-1.



10.3 Improvement in biodiversity values at an offset site

A BAR has been prepared to determine the credit values generated on the proposed offset sites (WSP Parsons Brinckerhoff 2017). The biodiversity assessment for the proposed Biobank sites included desk-based searches of relevant databases and historical records, as well as field inspections of the proposed Biobank sites.

The BAR prepared for the Biobanking agreement application is currently under assessment; the information in sections 10.3 and 10.4 below is as presented in the BAR and is subject to further review by OEH. Some changes to credit values and PCT definitions may occur following assessment and prior to finalisation of the Biobanking Agreement.

10.3.1 Ecosystem credits

The vegetation within the Wattle Grove Offset Area consisted of remnant and regrowth native vegetation that has been subjected to minor weed invasion in small areas. The majority of the vegetation within this offset area consists of remnant forest vegetation in moderate to good condition, representative of five PCTs within the Sydney Metro CMA.

The majority of the vegetation within the proposed Moorebank and Casula Offset Areas consisted of remnant vegetation in moderate condition, representative of one PCT within the Sydney Metro CMA (ME018).

The six PCTs identified in the biobank sites generate ecosystem credits as listed in Table 10-3.

Table 10-3 Availability of ecosystem credit offsets on proposed biobank site

| Plant community type | Area of PCT in biobank site | Ecosystem credits available on biobank site |
|---|-----------------------------|---|
| ME002 Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion | 12.83 ha | 146 |
| ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003) | 32.57 ha | 431 |
| ME004 Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion | 12.96 ha | 204 |
| ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | 19.32 ha | 259 |
| ME007 Coastal freshwater lagoons of the Sydney Basin and South-east Corner | 0.63 ha | 8 |

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| Plant community type | Area of PCT in biobank site | Ecosystem credits available on biobank site |
|---|-----------------------------|---|
| ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | 27.63 ha | 354 |

10.3.2 Species credits

The Wattle Grove Offset Area provides known habitat for at least six threatened plant species, as listed in Table 10-4, with populations of these species present within the area. The number of plants/stems and the species credits generated on the Wattle Grove Offset Area have been sourced from the BAR prepared for the application for the Biobanking agreement (WSP Parsons Brinckerhoff 2017), with additional reference to further surveys undertaken in September 2017 for the MPE Stage 1 Updated BAR (Arcadis 2017a).

The population numbers for some threatened species may increase if additional plants/stems are detected on the offset area. Each plant/stem recorded generates approximately 7.1 species credits under the Biobanking framework.

Following the discovery of a single male Koala within the Wattle Grove Offset Area, the detection dog searched the southern portion over one day in December 2018. Koala scats were detected by the dog at 13 locations within the southern portion of the Wattle Grove Offset Area during this period (Cumberland Ecology 2018). Further, one male animal was detected on an infra-red camera in the northern portion of Wattle Grove Offset Area (Cumberland Ecology 2019). Based on the relatively recent nature of the find and the current lack of understanding of the population present, no species polygons have been created for Koala, therefore no species credits have been created for this species. It is anticipated that species credits for Koala will be generated within the biobank site through a variation to the biobanking agreement.

Table 10-4 Availability of species credit offsets on proposed biobank site

| Species | Conservation status | Approximate number of individuals/area of habitat in Wattle Grove Offset Area | Species credits available in Wattle Grove Offset Area |
|--|--|---|---|
| <i>Acacia bynoeana</i> Bynoe's Wattle | EPBC Act: Vulnerable TSC Act: Endangered | 38 plants | 270 |
| <i>Acacia pubescens</i> Downy Wattle | EPBC Act: Vulnerable TSC Act: Vulnerable | 226 stems | 1,605 |
| <i>Grevillea parviflora</i> subsp. <i>parviflora</i> Small-flowered Grevillea | EPBC Act: Vulnerable TSC Act: Vulnerable | 6,186 stems | 43,921 |
| <i>Hibbertia fumana</i> | EPBC Act: not listed TSC Act: Critically Endangered (provisional listing) | 10.20 ha | 71 |
| <i>Hibbertia puberula</i> subsp. <i>puberula</i> | EPBC Act: Not listed TSC Act: Endangered | 24.66 ha | 178 |

| Species | Conservation status | Approximate number of individuals/area of habitat in Wattle Grove Offset Area | Species credits available in Wattle Grove Offset Area |
|--|---|---|---|
| <i>Persoonia nutans</i> Nodding Geebung | EPBC Act: Vulnerable TSC Act: Endangered | 258 plants | 1,832 |
| <i>Cercartetus nanus</i> Eastern Pygmy Possum | EPBC Act: not listed TSC Act: Vulnerable | 54.23 ha | 385 |
| <i>Myotis macropus</i> Southern Myotis | EPBC Act: not listed TSC Act: Vulnerable | 10 ha | 71 |

10.4 Credit balance

A comparison of the ecosystem and species credits calculated for the Amended Proposal Site, the adjacent MPE Stage 1 Project and MPE Stage 2 Proposal, and the proposed biobank site, was undertaken.

The comparison of ecosystem credits (Table 10-5) indicates that the proposed biobank site generates sufficient ecosystem credits to offset the biodiversity impacts of the MPE and MPW Projects on some PCTs, but that there is a deficit in the ecosystem credits required for offsets for ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin, and ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin. Variation rules will be applied where appropriate to offset these PCTs. If a credit deficit remains, then credits will be sourced from the market as available, or supplementary measures will be investigated in consultation with OEH.

Table 10-5 Ecosystem credit comparison

| PCT | Amended Proposal Site | | Ecosystem credits required for MPE Stage 1 Project | Ecosystem credits required for MPE Stage 2 Project (excluding Moorebank Ave Site) | Total species credits required for MPE and MPW Projects | Ecosystem credits available on biobank site | Ecosystem credits remaining |
|--|---|---|--|---|---|---|-----------------------------|
| | Ecosystem credits required for MPW Stage 2 Site | Ecosystem credits required for Moorebank Ave Site | | | | | |
| ME002 Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion | 0 | 0 | 0 | 3 | 3 | 146 | 143 |
| ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin | 371 | 167 | 102 | 4 | 644 | 431 | -213 |
| ME004 Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on | 0 | 0 | 0 | 0 | 0 | 204 | 204 |

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| PCT | Amended Proposal Site | | Ecosystem credits required for MPE Stage 1 Project | Ecosystem credits required for MPE Stage 2 Project (excluding Moorebank Ave Site) | Total species credits required for MPE and MPW Projects | Ecosystem credits available on biobank site | Ecosystem credits remaining |
|---|---|---|--|---|---|---|-----------------------------|
| | Ecosystem credits required for MPW Stage 2 Site | Ecosystem credits required for Moorebank Ave Site | | | | | |
| clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion | | | | | | | |
| ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin | 15 | 6 | 8 | 0 | 29 | 259 | 230 |
| ME007 Coastal freshwater lagoons of the Sydney Basin and South-east Corner | 0 | 0 | 3 | 0 | 3 | 8 | 5 |
| ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin | 1,289 | 27 | 60 | 0 | 1,376 | 354 | -1,022 |

The comparison of species credits (Table 10-4) indicates that the proposed biobank site generates sufficient species credits to offset the impacts of the MPE and MPW Projects on *Grevillea parviflora* subsp. *parviflora* and *Hibbertia fumana*, but that there is a deficit in the species credits required for offsets for *Hibbertia puberula* subsp. *puberula* and *Persoonia nutans*.

The eastern half of the Wattle Grove Offset Area has not previously been subject to targeted threatened flora survey for *Hibbertia puberula* subsp. *puberula*, but does contain a large area of suitable habitat for the species. Additional surveys for threatened flora species in this area are being undertaken in November - December 2017. Results are pending, but to date include over 900 additional plants of *Hibbertia puberula* subsp. *puberula* recorded, which should remove the deficit for this species.

If additional like-for-like species credits cannot be generated from the Wattle Grove Area, variation rules will be applied where appropriate. If a credit deficit remains, then credits will be sourced from the market as available, or supplementary measures will be investigated in consultation with OEH. .

Table 10-6 Species credit comparison

| Species | Species credits required for MPW Stage 2 Site | Species credits required for Moorebank Avenue Site | Species credits required for MPE Stage 1 Project | Species credits required for MPE Stage 2 Project (excluding Moorebank Ave Site) | Total species credits required for MPE and MPW Projects | Number of species credits available on biobank site | Species credits remaining |
|---|---|--|--|---|---|---|---------------------------|
| <i>Acacia bynoeana</i> Bynoe's Wattle | 0 | 0 | 0 | 0 | 0 | 270 | 270 |
| <i>Acacia pubescens</i> Downy Wattle | 0 | 0 | 0 | 0 | 0 | 1,605 | 1,605 |
| <i>Grevillea parviflora</i> subsp. <i>parviflora</i> Small-flowered Grevillea | 3,556 | 1,106 | 280 | 0 | 4,942 | 43,921 | 38,979 |
| <i>Hibbertia fumana</i> | 0 | 0 | 19 | 0 | 19 | 71 | 52 |
| <i>Hibbertia puberula</i> subsp. <i>puberula</i> | 38 | 43 | 30 | 58 | 169 | 178 | 9 |
| <i>Persoonia nutans</i> Nodding Geebung | 616 | 616 | 847 | 308 | 2,387 | 1,832 | -555 |
| Koala | 992 | 118 | 0 | 0 | 1,110 | 0 ⁴ | -1,110 |

⁴ A species polygon for Koala has not yet been created in the Wattle Grove offset area since the population and habitat use in this area is not well understood. A species polygon and therefore species credits may be created in this area in the future.

| Species | Species credits required for MPW Stage 2 Site | Species credits required for Moorebank Avenue Site | Species credits required for MPE Stage 1 Project | Species credits required for MPE Stage 2 Project (excluding Moorebank Ave Site) | Total species credits required for MPE and MPW Projects | Number of species credits available on biobank site | Species credits remaining |
|-------------------------------|---|--|--|---|---|---|---------------------------|
| <i>Phascolarctos cinereus</i> | | | | | | | |

10.4.1 Casula Offset Area

Condition E15 of the MPW Concept Approval (SSD 5066) requires the following:

all future Development Applications shall consider measures to improve the condition of the riparian corridor along the western bank of the Georges River (known as the 'hourglass' land).

The land known as the 'hourglass land' is associated with the development of the Rail Access Link delivered under the MPE Stage 1 SSD-6766 and is not included in Stage 2 of the MPW Project. Nevertheless, 'hourglass land' is a biobanking offset site in the proposed biobanking agreement application where it is referred to as the Casula Offset Area.

It is considered in detail in WSP Parsons Brinckerhoff (2017) where the following management objectives are proposed for Management Zone 12, which includes the entire Casula Offset Area:

- Reduce herbaceous weed coverage through primary and secondary works
- Suppress herbaceous weeds and exotic grasses through primary work (slashing)
- Prepare direct seeding areas through ripping plots
- Infill native canopy and shrub species through planting
- Prevent new weed incursions through regular maintenance works
- Reduce current weed densities to <50% exotic plant foliage cover
- Remove propagules from site (where appropriate) and raft biomass to decompose on site
- Hand plant tube stock of native canopy and shrub species into treated areas after initial works are completed to infill canopy gaps
- Assist the regeneration of native canopy, shrub and groundcover species.
- Monitor pest fauna presence.

11 CONCLUSION

This BAR has been prepared by accredited ecologists to support the assessment of the MPW Stage 2 Proposal by the Department of Planning (DP&E) and the Office of Environment and Heritage (OEH). This BAR replaces the BARs that were prepared to support the EIS, RtS and post RtS for the MPW Stage 2 Proposal (the Amended Proposal).

This BAR provides the following additional information:

- A validation of previous identification of *Hibbertia* species that occur in the Moorebank Avenue Site.
- Delineation of the biodiversity values and impacts of the Moorebank Avenue Site from the MPW Site, so that the Moorebank Avenue Site may be assessed and determined as either part of the MPW Stage 2 Proposal or the MPE Stage 2 Proposal (SSD 7709) (refer to section 1.2.2 for further detail).
- Review of Plant Community Type identification and additional quantitative analysis of PCT classification (as requested by OEH).
- Updated FBA calculations relating to impacts, predicted species and ecosystem credits and offsetting requirements.

This BAR has been prepared in accordance with the Framework for Biodiversity Assessment (FBA), as required by the SEARs. The BAR provides an assessment of potential biodiversity impacts of the Amended Proposal, at the Amended Proposal Site which includes both the MPE Stage 2 site and the Moorebank Avenue site.

The assessment is based on desktop research and detailed field surveys, undertaken across the MPW Site on a number of occasions between 2010 and 2017. The biodiversity impacts and offset requirements for the Amended Proposal Site were calculated using the FBA Credit Calculator in accordance with the FBA guidelines.

A total of 13 threatened flora species were identified in the FBA credit calculator as predicted flora species credit species. Three of the threatened flora species credit species identified by the credit calculator were recorded within the Amended Proposal Site: *Hibbertia puberula* subsp. *puberula*, *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora*.

A total of 24 threatened fauna species were derived from the PCTs identified on the Amended Proposal Site as predicted ecosystem credit species. None of the predicted threatened fauna ecosystem credit species were recorded on the Amended Proposal Site. Assessment of the potential presence of each species in the Amended Proposal Site found that 13 species were considered to have a moderate to high likelihood of occurrence.

Eight threatened fauna species were identified in the credit calculator as predicted fauna species credit species. Evidence of occurrence of Koala has been recorded from the Amended Proposal Site and this species is considered to be present. No other predicted threatened fauna species credit species were recorded or are considered likely to occur on the Amended Proposal Site.

The assessment considered the construction and operational impacts of the Amended Proposal. The potential biodiversity impacts of the Amended Proposal are as follows:

- Clearing of three Plant Community Types within the MPW Stage 2 Site:

- 9.81 hectares of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin. This PCT corresponds with the TEC Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion, which is listed as vulnerable under the TSC Act and endangered under the EPBC Act.
- 0.46 hectares of Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin. This PCT corresponds with the TEC Castlereagh Swamp Woodland, which is listed as endangered under the TSC Act.
- 27.88 hectares of Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin. This PCT corresponds with the TEC River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions, which is listed as endangered under the TSC Act.
- Clearing of three Plant Community Types within within the Moorebank Avenue Site. The total area of native vegetation to be cleared is 4.54 ha; the areas to be cleared comprise small, fragmented patches of vegetation and the disturbed edges of larger patches:
 - 3.73 hectares of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin, which is listed as vulnerable under the BC Act and endangered under the EPBC Act.
 - 0.22 hectares of Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion. This PCT corresponds with the TEC Castlereagh Swamp Woodland, which is listed as endangered under the BC Act.
 - 0.59 hectares of Forest Red Gum - Rough-barked apple grassy woodland on alluvial flats of the Cumberland Plain Sydney Basin. This PCT corresponds with the TEC River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions, which is listed as endangered under the BC Act.
- The Amended Proposal will have direct impacts on three threatened plant species;
 - Clearing of three threatened species that occur within MPW Stage 2 Site:
 - *Hibbertia puberula* subsp. *puberula* (0.94 hectares of habitat).
 - *Persoonia nutans* (7 plants).
 - *Grevillea parviflora* subsp. *parviflora* (249 stems)
 - Clearing of three threatened species that occur in the Moorebank Avenue Site:
 - *Hibbertia puberula* subsp. *puberula* (1.06 hectares of habitat).
 - *Persoonia nutans* (8 plants).
 - *Grevillea parviflora* subsp. *parviflora* (79 stems).
- The Amended Proposal will have direct impacts on one threatened species credit fauna species;
 - Clearing of 38.15 hectares of Koala habitat within the MPW Stage 2 Site.
 - Clearing of 4.54 hectares of Koala habitat within the Moorebank Avenue Site:
- Loss of specific fauna habitat components, including live trees, tree hollows, foraging resources, and groundlayer habitats such as ground timber and minor leaf litter. Removal of buildings currently within the Amended Proposal Site may remove potential marginal roosting habitat for microchiropteran bats.

- Potential for minor impacts to groundwater dependent ecosystems, such as drawdown of groundwater from the root zone, may occur as a result of excavation during construction. While this may have some potential to affect adjacent areas of retained vegetation and habitat that may utilise the shallow groundwater aquifers present, any impacts are expected to be minor given the limited scope of excavation proposed, particularly in the southern portion of the Amended Proposal Site. The detailed design process would further consider potential groundwater impacts and effects on groundwater-dependent ecosystems. In most cases, any impacts would be mitigated at the design phase
- Loss of existing habitat connectivity values due to the removal of patches of native vegetation that may allow native fauna to move into and through the Amended Proposal Site
- Construction activities in proximity to Georges River have the potential to adversely affect aquatic habitat.

Impacts on the identified ecological values have been avoided in the Amended Proposal as far as practicable. Where impacts cannot be avoided, the scale and extent of impacts has been determined, and a range of mitigation measures have been recommended to ameliorate impacts on the biodiversity values during and following construction.

The following offset requirements have been determined for the MPW Stage 2 Site:

- 371 ecosystem credits for Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin.
- 15 ecosystem credits for Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin.
- 1107 ecosystem credits for Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (Moderate/Good).
- 182 ecosystem credits for Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (Moderate/Good-Poor).
- 38 species credits for *Hibbertia puberula* subsp. *puberula*.
- 616 species credits for *Persoonia nutans*.
- 3556 species credits for *Grevillea parviflora* subsp. *parviflora*.
- 992 species credits for Koala.

The following offset requirements have been determined for the Moorebank Avenue Site:

- 167 ecosystem credits for Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin.
- 6 ecosystem credits for Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin.
- 27 ecosystem credits for Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin.
- 43 species credits for *Hibbertia puberula* subsp. *puberula*.

Moorebank Precinct West (MPW) - Stage 2 Amended Proposal

- 616 species credits for *Persoonia nutans*.
- 1106 species credits for *Grevillea parviflora* subsp. *parviflora*.
- 118 species credits for Koala.

The offset requirements related to values in the Moorebank Avenue Site may be included within the offset mechanism for the MPE Stage 2 Proposal or the MPW Stage 2 Proposal, subject to the timing of determination of the MPE Stage 2 Proposal and the MPW Stage 2 Amended Proposal.

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APPENDIX A

BIOBANKING CREDIT REPORT

Biodiversity credit report



This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 19/03/2019

Time: 10:12:42AM

Calculator version: v4.0

Major Project details

Proposal ID: 0023/2018/4882MP

Proposal name: MPW Stage 2 RtS v2

Proposal address: Moorebank Avenue Moorebank NSW 2170

Proponent name: Tactical Group

Proponent address: Level 15, 124 Walker Street North Sydney NSW 2060

Proponent phone: 0289070700

Assessor name: Jane Rodd

Assessor address: Level 5, 141 Walker Street NORTH SYDNEY NSW 2060

Assessor phone: 8907 8266

Assessor accreditation: 0023

Summary of ecosystem credits required

| Plant Community type | Area (ha) | Credits created |
|---|-----------|-----------------|
| Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion | 28.47 | 1,315.10 |
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion | 13.54 | 511.00 |
| Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion | 0.68 | 21.67 |
| Total | 42.69 | 1,848 |

Credit profiles

1. Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion, (ME005)

| | |
|-------------------------------------|---------------------------|
| Number of ecosystem credits created | 22 |
| IBRA sub-region | Cumberland - Sydney Metro |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|---|--|
| <p>Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion, (ME005)</p> <p>Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (ME002)</p> <p>Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (ME004)</p> <p>Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion, (ME021)</p> <p>Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion, (ME041)</p> | <p>Cumberland - Sydney Metro</p> <p>and any IBRA subregion that adjoins the IBRA subregion in which the development occurs</p> |

2. Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003)

| | |
|-------------------------------------|---------------------------|
| Number of ecosystem credits created | 511 |
| IBRA sub-region | Cumberland - Sydney Metro |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|--|---|
| Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003) | Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs |

3. Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (ME018)

| | |
|-------------------------------------|---------------------------|
| Number of ecosystem credits created | 1,315 |
| IBRA sub-region | Cumberland - Sydney Metro |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|--|---|
| Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (ME018) | Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs |

Summary of species credits required

| Common name | Scientific name | Extent of impact Ha or individuals | Number of species credits created |
|------------------------|--|---------------------------------------|---|
| Hibbertia puberula | Hibbertia puberula | 2.00 | 80 |
| Nodding Geebung | Persoonia nutans | 16.00 | 1,232 |
| Small-flower Grevillea | Grevillea parviflora subsp. parviflora | 333.00 | 4,662 |
| Koala | Phascolarctos cinereus | 42.69 | 1,110 |

APPENDIX B

TARGETED KOALA AND CUMBERLAND PLAIN LAND SNAIL SURVEYS

19 December 2018

Qube RE Services/SIMTA
c/o Rebecca Plemming
Allens
via email: <rebecca.plemming@allens.com.au>
cc: Felicity Rourke <felicity.rourke@allens.com.au>
Dennis Smith <dennis.smith@allens.com.au>

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**MOOREBANK INTERMODAL PRECINCT WEST - MPW STAGE 2 STATE
SIGNIFICANT DEVELOPMENT APPLICATION NO. SSD 16_7709
THREATENED SPECIES SURVEY RESULTS**

Dear Rebecca,

The purpose of this letter is to provide the results of the Koala surveys and Cumberland Plain Land Snail surveys conducted by Cumberland Ecology between 30 November and 7 December 2018 within parts of the Moorebank Intermodal Project boundaries, namely the Moorebank Precinct West (MPW) Stage 2 development site, the Moorebank offset area and the Wattle Grove offset area.

As you are aware, on 6 November 2018, a single male Koala (*Phascolarctos cinereus*), was recorded in the northern parts of the Wattle Grove offset area (also known as the 'Bootland') during routine nest box monitoring, being conducted by Arcadis as part of the Construction Flora and Fauna Management Plan (CFFMP) for the Moorebank Precinct East (MPE) Stage 1 development. The discovery of the Koala within the Bootland was actioned as an 'unexpected threatened species' find in accordance with the CFFMP as this species was assessed as unlikely to occur within the MPE and wider Moorebank Intermodal Terminal Precinct area. Further work was therefore required to clarify the nature and extent of Koala activity on both the offset area and the development area.

During the course of further koala habitat assessments following the unexpected find, an empty shell of a Cumberland Plain Land Snail (CPLS) was found within the Bootland on 9 November 2018. The discovery of the CPLS shell was also actioned as an unexpected find as this Endangered species has not been previously recorded on site and was also considered unlikely to occur.

As the unexpected finds could potentially affect the biodiversity assessment outcomes for the MPW Stage 2 development application currently being assessed by the NSW Department of Planning and Environment (DPE), further koala and

CPLS surveys were conducted by Cumberland Ecology within the MPW Stage 2 development site, Moorebank offset area and the Bootland. The purpose of these surveys was to determine the potential occurrence of koalas within the MPW Stage 2 development site and assess if further mitigation and/or compensation strategies were required for the MPW Stage 2 development, in light of the unexpected finds.

No koalas were observed during the surveys conducted by Cumberland Ecology. However koala faecal pellets (scats) were found at multiple locations within both the Bootland and the south-eastern parts of the MPW development site. No further individuals (live animals or shells only) of CPLS were found during the surveys and habitat assessments determined that limited marginal habitat for CPLS was present within the MPW development site.

Based on the results of our surveys as well as site specific conditions and constraints, no further mitigation measures and/or compensation measures beyond those submitted as part of the MPW Stage 2 development application are required for CPLS. However, based on the finding of further koala scats within the MPW and Bootland sites, some additional mitigation measures for koalas, including but not limited to, preparation of a Koala Management Plan are warranted.

The results of our surveys and associated recommendations are detailed in **Appendix A** to this letter. Figures showing locations of the surveys and koala scats are provided in **Appendix B**, and survey photographs are provided in **Appendix C**.

If any further information is required, or if you would like to discuss this matter further, please do not hesitate to contact myself, or Gitanjali Katrak, on (02) 9868 1933.

Yours sincerely



David Robertson

Director

david.robertson@cumberlandecology.com.au

Appendix A

Moorebank Intermodal Precinct -
Threatened Fauna Surveys

A.1 Background

Cumberland Ecology was requested by Allens, on behalf of Qube RE Services Pty Ltd (Qube) and the Sydney Intermodal Terminal Alliance (SIMTA), to provide additional ecological advice in relation to the adequacy of the biodiversity assessment documents submitted to the Department of Planning and Environment (DPE) for State Significant Development Application No. SSD 16_7709 for Stage 2 of the Moorebank Intermodal Precinct West development (MPW 2 DA) in light of recent unexpected discoveries of threatened fauna species in the vicinity of the development area.

The Moorebank Intermodal Terminal Precinct (the Intermodal Precinct) is broadly comprised of two main areas: Moorebank Precinct West (MPW) and Moorebank Precinct East (MPE). Although the MPW and MPE sites and the various stages therein have been assessed as separate State Significant Development applications, the proposed offset sites – Wattle Grove offset area (also known as the 'Bootland'), Casula offset area and the Moorebank offset area – collectively service offsetting requirements for the entire Intermodal Project.

The Land and Environment Court of NSW granted consent for the MPE Stage 1 project on 13 March 2018 subject to Conditions of Consent including, but not limited to, ongoing mitigation and management under a Construction Flora and Fauna Management Plan (CFFMP).

On 6 November 2018, a single male Koala (*Phascolarctos cinereus*), was recorded in the northern parts of the Bootland during routine nest box monitoring, being conducted by the Arcadis as per the requirements of the CFFMP for the MPE Stage 1 project. The discovery of the Koala within the Bootland was actioned as an 'unexpected threatened species' find as per the CFFMP as this species was considered unlikely to occur within the MPE and wider Intermodal Precinct area in all ecological assessments conducted to date.

During the course of further koala habitat assessments conducted in accordance with parts of the expected finds procedures, an empty shell of a Cumberland Plain Land Snail (CPLS) was found near the northern boundary of the Bootland on 9 November 2018. The discovery of the CPLS shell was also actioned as an unexpected find as this Endangered species has not been previously recorded on site and was considered unlikely to occur in all ecological assessments conducted to date.

As the unexpected finds could potentially affect the biodiversity assessment outcomes for the MPW 2 DA currently being assessed by DPE, further koala and CPLS surveys were conducted by Cumberland Ecology within the MPW development site, Moorebank offset area and the Bootland. The purpose of these surveys was to determine the potential occurrence of koalas and CPLS within the MPW development site and assess if further mitigation and/or compensation strategies, beyond those currently proposed within the submitted documentation for MPW 2 DA were required in light of the unexpected finds.

A.2 Methodology

A.2.1 Document review

Relevant sections pertaining to threatened fauna and fauna habitat within the following documents prepared for the MPW 2 DA, as provided by Allens in the brief to expert, were reviewed:

- Biodiversity Assessment Report and Wetlands Assessment dated October 2016;
- Response to Submissions Report (RTS) dated July 2017;
- Updated Biodiversity Assessment Report (the Updated BAR) dated June 2017;
- Updated Biodiversity Assessment Report (the Further Updated BAR) dated July 2018;
- Unexpected find of threatened species (Koala) – Notification to Office of Environment and Heritage (OEH), dated 9 November 2018;
- Unexpected find of threatened species (Cumberland Plain Land Snail) – Notification to Office of Environment and Heritage (OEH), dated 23 November 2018;
- Unexpected find of threatened species (Koala) - Arcadis Notification and advisory letter to SIMTA/Qube, dated 28 November 2018; and
- Unexpected find of threatened species (Cumberland Plain Land Snail) - Arcadis memorandum to SIMTA/Qube, dated 28 November 2018.

A.2.2 Rapid Spot Assessment Technique surveys

Koala surveys were undertaken on 30 November 2018 using a variant of the standard Spot Assessment Technique (SAT) methodology known as Rapid – SAT. Rapid-SAT surveys are utilised as a precursor to detailed SAT surveys as this approach is thought to offer a time and very cost effective survey technique based on the knowledge that in areas being utilised by koalas, there is a 50% probability of faecal pellets occurring within 1 m of the base of any Preferred Koala Food Trees (PKFT) ≥ 300 mm diameter at breast height (DBH) (*Phillips and Wallis 2016*). If evidence of Koalas is detected, Rapid-SATs are followed by full SATs until the entire area of koala activity is captured.

A 250 m sampling grid was established over the proposed study area which comprised the MPW Stage 2 development area, Moorebank offset area and the Bootland, with a total of 31 Rapid-SAT survey sites established across the study area. As Rapid-SATs allow for some flexibility in site placement (± 25 m) to optimise numbers of PKFTs being sampled, sites were adjusted as required in the field.

Based on vegetation mapping and trees (including planted natives) recorded within the study area, as provided in the ecological documentation for the MPW and MPE sites, the PKFTs within the study area comprise:

- Primary feed trees: *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus parramattensis* (Parramatta Red Gum), *Eucalyptus microcorys* (Tallowwood);
- Secondary fee trees: *Eucalyptus moluccana* (Grey Box), *Eucalyptus longifolia* (Woollybutt), *Eucalyptus baueriana* (Blue Box); and.
- Supplementary species: *Eucalyptus eugenioides* (Thin-leaved Stringybark).

At each Rapid SAT survey site, a maximum of two-person minutes was spent searching for faecal pellets (scats) within a one metre radius of the base of each selected tree and continued until a minimum of five to a maximum of seven PKFTs were searched. Searching for scats involved an initial inspection of the ground surface followed by a robust disturbance, i.e. raking of the leaf litter if necessary to search for scats. Searching ceased if a Koala scat was located before the two minutes expired.

At survey sites with no PKFTs (including within the $\pm 25\text{m}$ adjustment area), brief searches, up to one-person minute, were conducted at the base of dominant trees present such as *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus fibrosa* (Broad-leaved Ironbark).

A.2.3 IR cameras

Seven Infra-Red (IR) cameras were set up on 30 November 2018 in areas with high numbers of PKFTs or potential movement corridors for koalas. The IR cameras were placed in suitable trees facing PKFTs, at a height of approximately two metres.

The locations of IR cameras within the study area are shown in **Figure 1 of Appendix B**

A.2.4 Koala detection dog

Surveys using a koala detection dog were conducted from 3 – 7 December 2018 with ecologists from Cumberland Ecology accompanying the ReconEco handler/dog team.

The nominated detection dog, Jet, is a working Springer Spaniel certified for Koala pellet detection with the Canine Detection Certification Council - Conservation Division (CDCC). The nominated handler, Craig Faulkner, is a professionally trained detection dog handler, certified by the CDCC.

The handler allowed the dog to work off leash and follow any scents as far as practical and safe. The surveys involved the handler giving the dog the general direction of the search and guiding/recalling the dog if it strayed too far or to keep the dog safe from risks. The detection dog was fitted with a real-time radio-tracking collar paired with the handler's handheld GPS unit to maintain a record of the areas surveyed and distance covered by the detector dog. Photographs taken during the dog detection surveys, showing the detection dog at work, are provided in **Appendix C**.

When the dog displayed particular interest in an area, by sitting beside a tree after following a scent, the handler recalled the dog and then rereleased him for a follow-up search. If the dog returned to the point of interest, the handler notified the accompanying Cumberland Ecology

ecologists who then conducted searches for scats at the base of the tree of interest as well as any adjacent trees.

The location of any detected scats was recorded using hand-held GPS units and samples were collected for further laboratory confirmation analyses. In areas where high numbers of scats were recorded, PKFTs and adjacent sheltering trees were inspected for koalas.

A.2.5 Koala Scat Identification

A subset of scat samples located during the dog detection surveys, particularly those within the MPW development area, were collected and sent to Ms Georgeanna Story at ScatsAbout for further identity verification.

A.2.6 Cumberland Plain Land Snail surveys

Surveys for Cumberland Plain Land Snails (CPLS) were conducted concurrently with the detection dog surveys. The habitats surveyed during the koala detection dog surveys were assessed for suitability to support CPLS and searches were conducted at the base of trees with a diameter at breast height of greater than 10 cm and suitable levels of litter and other CPLS habitat within one metre of the base of the tree.

A.2.7 Limitations

Due to time limitations, only 16 of the 31 Rapid-SAT survey points were assessed on 30 November 2018. However the sites that were not assessed using Rapid-SATs were either located in the vicinity of the area where a koala was first detected or were subsequently surveyed during the detection dog surveys. As the purpose of Rapid-SATs is to detect evidence of koalas within an area, further Rapid-SAT surveys were deemed unnecessary.

Due to a device fault on the day, the distance covered by the detection dog was not properly recorded on 4 December 2018. Therefore the shorter distance covered by the dog handler has been utilised for survey effort calculations for this day.

As the surveys conducted from 3-7 December 2018 were primarily focussed on koalas, survey effort for CPLS was restricted and searches for CPLS were not conducted in areas/habitats which were deemed unsuitable habitat for CPLS such as areas lacking litter or highly weed infested areas.

Due to time limitations, scats found within the Bootland on 7 December 2018 were not included in the samples sent to ScatsAbout for laboratory analysis. Samples sent for identification were limited to the scats collected during the Rapid-SAT surveys on 30 November 2018 and during the detection dog surveys within the MPW development site on 5 December 2018.

A.3 Results

A.3.1 Koala

i. Rapid SAT surveys

Rapid-SAT surveys were conducted at 16 of the 31 nominated survey sites. Koala scats were detected at one survey site within the Bootland under a *Eucalyptus eugenioides* tree. Additional scats were also incidentally located under a *Eucalyptus fibrosa* tree in the vicinity of the *Eucalyptus eugenioides* tree. The locations where the scats were found is shown in **Figure 2** of **Appendix B**. These scats located were identified as 'probable' Koala scats by Ms Story as they did not display all the diagnostic characteristics, although majority were present.

No scats were recorded within the MPW development area or Moorebank offset area during the Rapid SAT surveys and no koalas were sighted during the Rapid SAT surveys.

ii. Detection Dog surveys

Koala scats were found at the base of several trees across two 'patches' of vegetation during the detection dog surveys. The location of these scats is shown in **Figure 2**.

One detection 'patch' was located in the southern parts of the Bootland, with scats being found at the base of a variety of tree species including *Eucalyptus parramattensis*, *Eucalyptus sclerophylla*, *Eucalyptus fibrosa*, *Angophora floribunda* and *Melaleuca decora*. The vegetation within this patch is mapped as a mix of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (equivalent to Castlereagh Scribbly Gum Woodland threatened ecological community (TEC)), Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest (equivalent to Cooks River Castlereagh Ironbark Forest TEC) and Parramatta Red Gum woodland on moist alluvium (equivalent to Castlereagh Swamp Woodland TEC).

One patch was located in the south-eastern parts of the MPW development area. This vegetation comprises a narrow stretch of vegetation, occurring roughly parallel to Moorebank Avenue and has been mapped as a mix of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland (equivalent to Castlereagh Scribbly Gum Woodland TEC) and Parramatta Red Gum woodland on moist alluvium (equivalent to Castlereagh Swamp Woodland TEC). Scats were generally found at the base of either *Eucalyptus parramattensis* or *Eucalyptus sclerophylla* trees.

It is noted that scats were located at the base of trees that are not considered primary, secondary or supplementary PKFTs in both the MPW development site and Bootland. However these trees still comprise potential shelter for koalas. However scats are known to be found under non PKFTs (*Phillips and Wallis 2016*).

The distance covered by the detection dog varied each day. The survey effort, expressed as a ratio of the number of locations of scat detection to distance surveyed is summarised in **Table 1** below.

Table 1 **Detection dog survey effort**

| Survey date | Location | Distance covered by detection dog (km) | Number of locations of detected scats | Detection/unit effort (# scats/km) |
|-------------|-----------------------|---|---|---------------------------------------|
| 03-12-18 | MPW development site | 16.24 | 0 | 0.00 |
| 04-12-18 | MPW development site | 11.74* | 0 | 0.00 |
| 05-12-18 | MPW development site | 18.98 | 5 | 0.26 |
| 06-12-18 | Moorebank offset area | 19.8 | 0 | 0.00 |
| 07-12-18 | Bootland | 14.62 | 13 | 0.89 |

* Distance covered by the dog handler used as a proxy due to a device fault on the day. Distance covered by the detector dog would be higher.

Overall the detection rate for koala scats within the Bootland was approximately 3 times that within the MPW development area. This suggests a higher density of koala scats and therefore higher level of koala useage of vegetation within the Bootland compared to the MPW development site.

iii. *Scat Identification*

Although some scats collected from the MPW development site were identified as 'probable' Koala scats as they did not display all the diagnostic characteristics, laboratory analysis of the scats by Ms Story confirmed that the majority of the samples collected from the MPW development to be Koala scats. Despite the 'probable' diagnosis, the scats are assumed to comprise koala scats as they were found by a detection dog that is attuned to koala detection and is not trained for detection of alternate native fauna with similar scats.

iv. *IR cameras*

There are no results for the IR cameras as the cameras are currently still deployed on site at the time of preparation of this report.

However any relevant data obtained from the IR cameras will be utilised to help inform the additional management and/or mitigation measures for koalas (see **Section A.4**)

A.3.2 *Cumberland Plain Land Snail*

No CPLS individuals were found in the study area during the surveys conducted by Cumberland Ecology.

Majority of the vegetation within the MPW development area and Moorebank offset area was assessed as unsuitable habitat for CPLS as these areas mainly comprised:

- Areas with mown understorey and lack of litter;

- Areas dominated by trees which do not support CPLS such as Casuarinas and Melaleucas; and
- Areas with very high density of exotic grasses such as *Eragrostis curvula*.

Photographs showing vegetation condition and lack of CPLS habitat across various parts of the MPW site are provided in **Appendix C**.

Although some suitable habitat for CPLS is present within the Bootland, no CPLS individuals (live or shells) were found during searches of suitable habitat trees with litter at the base.

A.4 Discussion and Recommendations

A.4.1 Koala

i. Current Koala numbers within Intermodal Precinct

Although no koalas were sighted during the December 2018 surveys, scats were found across two areas of vegetation, one within the Bootland and one along the south-east corner of the MPW development site.

As home-range size for koalas can vary with quality of habitat and range from less than two hectares to several hundred hectares in size (OEH 2018a), the number of koalas occurring within the different parts of the wider Intermodal Precinct cannot be estimated based on the presence of the scats.

Although the scat data implies that there is potential for more than one koala to be present within the wider Intermodal Precinct, it is also feasible that the single vagrant male observed on 6 November 2018 is migrating between the MPW site and the Bootland. Although Moorebank Avenue and the 1.8m high cyclone fence along existing work sites present hostile barriers for movement, a culvert along Anzac Creek, running beneath Moorebank Avenue presents a possible fauna passage for koalas to move between the Bootland and the MPW development area during dry periods. It is noted that all scats located within the MPW development area are restricted to a band of vegetation adjacent to the culvert opening. Although it is acknowledged that this observation is circumstantial, the potential for movement between the Bootland and the MPW development area through the culvert during dry periods cannot be fully discounted.

The detection/unit effort by the detection dog indicates that koala usage of the Bootland is higher than that of the MPW development area, implying a possible preference for habitat within the Bootland compared to the more fragmented habitat within the MPW development area.

ii. Koala occurrence within Intermodal Precinct

Previous biodiversity assessments prepared for the various stages of the wider Intermodal Precinct assessed koala as unlikely to occur based on results of various field surveys within the Intermodal Precinct, none of which detected the presence of koalas. However that survey data is greater than five years old and should not be relied upon due to potential:

- changes in Koala numbers in the general locality; and
- changes in vegetation cover and available habitat in the general locality.

Based on the data collected during the 2018 field surveys by Cumberland Ecology (December) and Arcadis (November) as well as anecdotal evidence, there are several potential reasons for the recent recordings of koalas within the wider Intermodal Precinct. These include:

1. **Translocation following fire:** Based on personal communications with koala expert Dr Stephen Phillips, it is understood that at least one koala was rescued from the recent bushfires within the Holsworthy army base during late July – early August 2018 and released into adjoining “unburnt bushland”. Although the precise area where the koala was released is unknown, given the proximity of the Intermodal Precinct to the Holsworthy base, it is feasible that one or more rescued koalas may have been released into unburnt bushland between the burnt areas and the Bootland. Although the East Hills railway line forms a movement barrier between the Intermodal Precinct and the Holsworthy base, the presence of culverts beneath the railway line present potential fauna passages.

During the surveys conducted by Cumberland Ecology, gaps in the fence were found at some locations around the Bootland which would further allow movement into the Bootland. Therefore it is feasible that koalas have not historically occurred within the Intermodal Precinct areas and that the recent koala sightings and scat detection comprise one or more individuals that have moved into the Bootland and the adjacent parts of the MPW development site following release into nearby bushland.

2. **Natural Dispersal and Long term undetected presence of small numbers of animals in Boot Lands:** The bushland areas within the Intermodal Precinct occur at the northern extent of a large area of bushland that is known to support Koala populations and includes the Holsworthy Military Reserve and areas within the Campbelltown Local Government Area identified as Koala Habitat Linkage Areas in the Campbelltown Comprehensive Koala Plan of Management.

Although koalas are generally solitary, they have a complex social hierarchy based on a dominant male with a territory overlapping with that of several females with subordinate males occurring on the periphery (OEH 2018a). As koala home-ranges can spread over several hundred hectares, it is feasible that the bushland within the Intermodal Precinct, the Bootland in particular, comprises the northern limits of koala territories and that this species has always utilised the Bootland vegetation as part of a wider foraging range. As previously stated the presence of culverts (fauna passages) and gaps in existing fencing would allow for movement of koalas from adjacent bushland despite hostile barriers from ongoing development in the locality and individuals were not recorded during previous surveys due to the very low density of occurrence within the area.

The basis for the recent occurrence of koala(s) in areas where they were previously not thought to occur cannot be determined based on current available data. However, regardless of the

origin of animals on site, the current survey data indicates that density of koalas within the Intermodal Precinct (including the offset and conservation areas) is low and is likely to comprise vagrant foraging individuals as opposed to a resident breeding population.

iii. Recommendations

Although the density of koalas within the Intermodal Precinct (including offset areas and conservation areas) is likely to be low, further mitigation measures, beyond those listed within the submitted biodiversity assessments are warranted, in light of the recent 2018 field survey records.

In the event that the koala occurrence within the MPW development site comprises individual(s) moving between the site and adjacent bushland, increased measures are required to prevent koalas entering the vegetated areas within the development site. This would include measures such as installation of boundary fences that do not have any gaps between the bottom of the fence and the ground to prevent koalas from entering under the boundary fences and regular maintenance to fix any damaged sections that could result in gaps in the fenceline. Additional fencing should be installed to separate the future development areas from the Moorebank offset area.

As the Anzac creek culvert comprises a potential fauna passage between the Bootland and the MPW development area, measures to prevent entry into the culvert such as a grill or mesh should be installed at the entrance and exit of the culvert. Consideration should also be given to installing one-way koala bridges that would only allow for west to east koala movements into the Bootland, thereby funnelling koalas away from the development area.

The current proposed mitigation measures proposed as part of the MPW Stage 2 DA include the preparation of a Construction Environment Management Plan (CEMP). A detailed Koala Management Plan (KMP) should be developed for inclusion in the CEMP and should be prepared in consultation with OEH and/or a recognised koala specialist to determine the most accurate method to determine presence and numbers of any koalas within the MPW development area. These surveys should be conducted as comprehensive pre-clearance SAT surveys following detailed design and prior to construction works.

In addition to the detailed pre-clearance surveys, the Koala Management Plan should include protocols to relocate any potential vagrant individuals that may still be present within the development area following management strategies to prevent entry into the development area or encourage movement into the offset areas. As relocation is likely to cause considerable stress during the capture process, a recognised koala specialist should be consulted to develop an appropriate relocation protocol to minimise stress during the relocation process.

As previously stated, the proportionately higher density of scats located within the Bootland implies a possible preference for habitat within the Bootland compared to the more fragmented habitat within the MPW development area. The recommended mitigation measures are deemed suitable to either prevent further movement into the development area or encourage movement into the offset areas and therefore compensatory measures are not considered to be necessary at this stage.

However in the event that pre-clearance surveys conclusively determine the presence of resident individuals as opposed to vagrants within the MPW development area, an appropriate offset using Koala credits should be calculated. Detailed surveys for Koalas should be conducted within the Bootland to determine if suitable numbers of credits can be generated within the Bootland to suitably offset any credit requirements within the MPW development area.

A.4.2 Cumberland Plain Land Snail

The CPLS primarily inhabits Cumberland Plain Woodland but is also known from Shale Gravel Transition Forest, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest. It lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps (OEH 2018b).

The CPLS shell was found in the Bootland beneath leaf litter at the base of a *Eucalyptus longifolia* (Woollybutt) along the northern edge of vegetation within a patch of vegetation mapped as Broad-leaved Ironbark Melaleuca decora shrubby open forest. This community corresponds to the TEC Cooks River Castlereagh Ironbark Forest which can intergrade into Shale-Gravel Transition Forest, Castlereagh Swamp Woodland and Castlereagh Scribbly Gum Woodland.

It should be noted that the preferred habitat community for the CPLS, namely Cumberland Plain Woodland, as well as the supplementary habitat communities Shale Gravel Transition Forest and Castlereagh Swamp Woodland are absent from the MPW development area. Cooks River Castlereagh Ironbark Forest, where the unexpected find was located, is also absent from the MPW development area.

Although the River-flat Eucalypt Forest (RFEF) (mapped as Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats) community is present within the MPW development site and Moorebank offset area, this community is considered to be marginal habitat for the CPLS (OEH 2018). Furthermore, the RFEF vegetation present within the MPW development site and Moorebank offset area is highly modified, with high levels of weed infestations such as dense growth of *Lantana camara* (Lantana) and *Eragrostis curvula* (African Love Grass) which is unlikely to support a population of CPLS due to lack of suitable habitat conditions.

The woodland to open forest vegetation communities within the Bootland provide some potential habitat for the CPLS. However the lack of CPLS records during targeted surveys conducted across the entire Moorebank Intermodal Terminal Precinct between 2011 and 2016, suggests that any occurrence of CPLS within the Bootland is likely to be small and fragmented. There is no evidence of a widespread population on site.

The CPLS is a relatively immobile species with a small home range and is unlikely to migrate outside of preferred woodland habitat. There are also significant hostile barriers such as the MPE development site, Moorebank Avenue and the East Hills passenger rail line that between the Bootland and MPW development site that would prevent dispersal from the Bootland into the MPW development site.

Although the current biodiversity assessment documents for MPW 2 DA consider the CPLS as unlikely to occur, the proposed mitigation measures such as pre-clearance surveys include consideration of CPLS in the searches for native fauna. Therefore, based on the relative lack of suitable habitat for CPLS within the MPW development site and limited dispersal potential from the Bootland, no further mitigation measures beyond those proposed within the submitted biodiversity documents are required in relation to the CPLS.

However, it is noted that the pre-clearance surveys for the MPW development area broadly mention relocating any captured fauna into the retained riparian vegetation of the Georges River corridor (the Moorebank offset area). As the Bootland contains more suitable habitat/preferred vegetation communities compared to those present within the Moorebank offset area, it is recommended that any live CPLS individuals, if located during pre-clearance surveys for the MPW development area, are relocated into areas of Shale-Gravel Transition Forest, Castlereagh Swamp Woodland or Cooks River Castlereagh Ironbark Forest within the Bootland.

A.5 Conclusions

Based on the results of the latest Koala investigations, it is recommended that additional mitigation measures are implemented for Koalas.

As no koalas or koala scats were found across the majority of the MPW development area despite intensive searches, compensation measures for koalas are not necessary. However, consideration of compensation measures would be required if future pre-clearance surveys determine the presence of resident individuals as opposed to vagrants within the development site.

The proposed mitigation measures to date for the Cumberland Plain Land Snail are deemed appropriate, despite the unexpected find within the Bootland and no further mitigation measures for Cumberland Plain Land Snail are warranted.

A.6 References

OEH (2018a). Koala - profile. Office of Environment and Heritage, Hurstville

OEH (2018b). Cumberland Plain Land Snail - profile. Office of Environment and Heritage, Hurstville.

Phillips. S., and Wallis, K. (2016). Koala Likelihood Mapping - Baseline Koala Survey Analysis and Reporting. Final Report to NSW Environment Protection Authority

Appendix B

Figures



Legend

- Moorebank Precinct West (MPW) Development Site
- Moorebank Offset Area
- Wattle Grove Offset Area/Bootland
- Rapid-SAT Survey Locations
- IR Camera Locations

Koala Detection Dog Tracks

- Monday (3/12)
- Tuesday (4/12)
- Wednesday (5/12)
- Thursday (6/12)
- Friday (7/12)

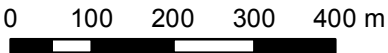
Coordinate System: MGA Zone 56 (GDA 94)



Image Source:
Image © NearMap 2018
Dated: 2/11/2018



Figure 1. Koala survey effort





Legend

- Moorebank Precinct West (MPW) Development Site
- Moorebank Offset Area
- Wattle Grove Offset Area/Bootland
- Koala Detection Dog - Scats
- Rapid-SATs - Scats

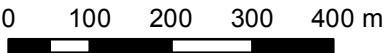
Coordinate System: MGA Zone 56 (GDA 94)



Image Source:
Image © NearMap 2018
Dated: 2/11/2018



Figure 2. Koala survey results



Appendix C

Photographs



Photograph 1 Koala detection dog working in ME003 - Hard-leaved Scribbly Gum Parramatta Red Gum woodland community



Photograph 2 Close up of Koala detection dog, Jet



Photograph 3 Koala scats found by detection dog in ME005 – Parramatta Red Gum on moist alluvium woodland



Photograph 4 **Anzac creek culvert opening within MPW development site – potential fauna crossing passage**



Photograph 5 ***Melaleuca* dominated woodland in MPW development site – suitable CPLS habitat absent**



Photograph 6 **Scattered Ironbarks with *Eragrostis curvula* dominated understorey – suitable CPLS habitat absent**



Photograph 7 ***Casuarina* dominated woodland in MPW development site – suitable CPLS habitat absent**



Photograph 8 **Scattered Red Gums with *Eragrostis curvula* dominated understorey – no CPLS detected**



Photograph 9 **Scattered Scribbly-Gums with mown understorey – suitable CPLS habitat absent**

22 February 2019

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**MOOREBANK INTERMODAL PRECINCT WEST - MPW STAGE 2 STATE
SIGNIFICANT DEVELOPMENT APPLICATION NO. SSD 16_7709 INFRA-
RED CAMERA SURVEY RESULTS**

Dear Rebecca,

The purpose of this letter is to provide the results of the Infra-red (IR) camera surveys conducted by Cumberland Ecology between 30 November and 19 December 2018 within parts of the Moorebank Intermodal Project boundaries, namely the Moorebank Precinct West (MPW) Stage 2 development site, the Moorebank offset area and the Wattle Grove offset area.

1. Background

Cumberland Ecology conducted several Koala surveys within the Moorebank Intermodal Project Area in December 2018 following the initial discovery of a single male Koala (*Phascolarctos cinereus*) on 6 November 2018 in the northern parts of the Wattle Grove offset area (also known as the 'Bootland') during routine nest box monitoring, being conducted by Arcadis as part of the Construction Flora and Fauna Management Plan (CFFMP) for the Moorebank Precinct East (MPE) Stage 1 development.

The results of these December 2018 surveys are detailed in our letter report entitled '*Moorebank Intermodal Precinct West – MPW Stage 2 State Significant Development Application No. SSD 16_7709: Threatened Species Survey Results*' (REF: 18194 – Let2, dated 19 December 2018) (Survey Report). As detailed in the Survey Report, the koala survey methodologies utilised included:

- Rapid Spot Assessment Surveys (Rapid SATs);
- Koala detection dog surveys; and

- IR camera surveys.

At the time of preparing the Survey Report, the results of the IR camera surveys were not available. In particular, page 9 of Appendix A of the Survey Report stated:

"IR cameras

There are no results for the IR cameras as the cameras are currently still deployed on site at the time of preparation of this report.

However any relevant data obtained from the IR cameras will be utilised to help inform the additional management and/or mitigation measures for koalas (see Section A.4)."

This letter therefore serves as an addendum to the Survey Report and presents the results of the IR camera surveys.

2. Methods

A total of seven IR cameras were set up on 30 November 2018 in areas with high numbers of Preferred Koala Food Trees (PKFTs) or potential movement corridors for koalas. The IR cameras were placed in suitable trees facing PKFTs, at a height of approximately two metres and were programmed to take a set of three continuous photos when the motion trigger was activated. The locations of IR cameras within the Moorebank Intermodal Project boundaries are shown in **Figure 1 of Appendix A**.

The IR cameras were collected on 19 December 2018 and all photographs taken were examined by an ecologist between 8 and 10 January 2019 for presence/absence of fauna.

3. Results

Several fauna species, both native and exotic, were identified in the IR camera photographs.

One koala was detected on an IR camera (IR 24) located within the Bootland on 9 December 2018. Although the photograph quality does not allow for a definitive gender identification, based on the size of the koala, the detected individual appears to be a young male.

The relevant IR camera is located between areas where koala scats were detected during the December 2018 surveys (see **Figure 2 of Appendix A**). The koala photographs, as captured by the IR camera, are provided in **Appendix B**.

No other threatened fauna species were identified in the IR camera photographs. Other fauna identified on the IR camera photographs included:

- Australian Magpie (*Cracticus tibicen*);
- Australian Raven (*Corvus coronoides*);
- Brown Goshawk (*Accipiter fasciatus*);

- Crested Pigeon (*Ocyphaps lophotes*);
- Spotted Dove (*Streptopelia chinensis*);
- Superb Fairy-wren (*Malurus cyaneus*);
- Black Rat (*Rattus rattus*);
- Brown Mouse (*Mus musculus*);
- Brushtail Possum (*Trichosurus vulpecula*);
- Bush Rat (*Rattus fuscipes*);
- Echidna (*Tachyglossus aculeatus*);
- European Hare (*Lepus europaeus*);
- Fox (*Vulpes vulpes*); and
- Swamp Wallaby (*Wallabia bicolor*).

4. Discussion and Recommendation

The detection of a koala on the IR camera supports the findings of the December 2018 surveys that at least one Koala is present within the bushland areas of the Bootland. Although no koalas were detected by IR cameras within the MPW development area, there is still potential for koalas to occur based on the presence of scats, as detailed in the Survey Report.

The data from the IR cameras do not indicate any requirement for additional management and/or mitigation measures for koalas, beyond those detailed in the Survey Report. Therefore the mitigation recommendations, as outlined in the Survey Report remain valid.

If any further information is required, or if you would like to discuss this matter further, please do not hesitate to contact myself, or Gitanjali Katrak, on (02) 9868 1933.

Yours sincerely



David Robertson

Director

david.robertson@cumberlandecology.com.au

Appendix A

Figures



Legend

- Moorebank Precinct West (MPW) Development Site
- Moorebank Offset Area
- Wattle Grove Offset Area/Bootland
- IR Camera Locations

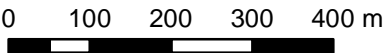
Coordinate System: MGA Zone 56 (GDA 94)



Image Source:
Image © NearMap 2018
Dated: 2/11/2018



Figure 1. IR Camera Locations





Legend

- Moorebank Precinct West (MPW) Development Site
- Moorebank Offset Area
- Wattle Grove Offset Area/Bootland

Koala Indicators

- Koala Detection Dog - Scats
- Rapid-SATs - Scats
- IR camera recording

Coordinate System: MGA Zone 56 (GDA 94)



Image Source:
Image © NearMap 2018
Dated: 2/11/2018

cumberland
ecology

Figure 2. Locations of Koala indicators

0 100 200 300 400 m

Appendix B

Infra-red Camera Photographs - Koala





